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Popular Science

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Victrola XVII, electric, $300
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Victrola

New Victor Records demonstrated at all dealers on the 28th of each month

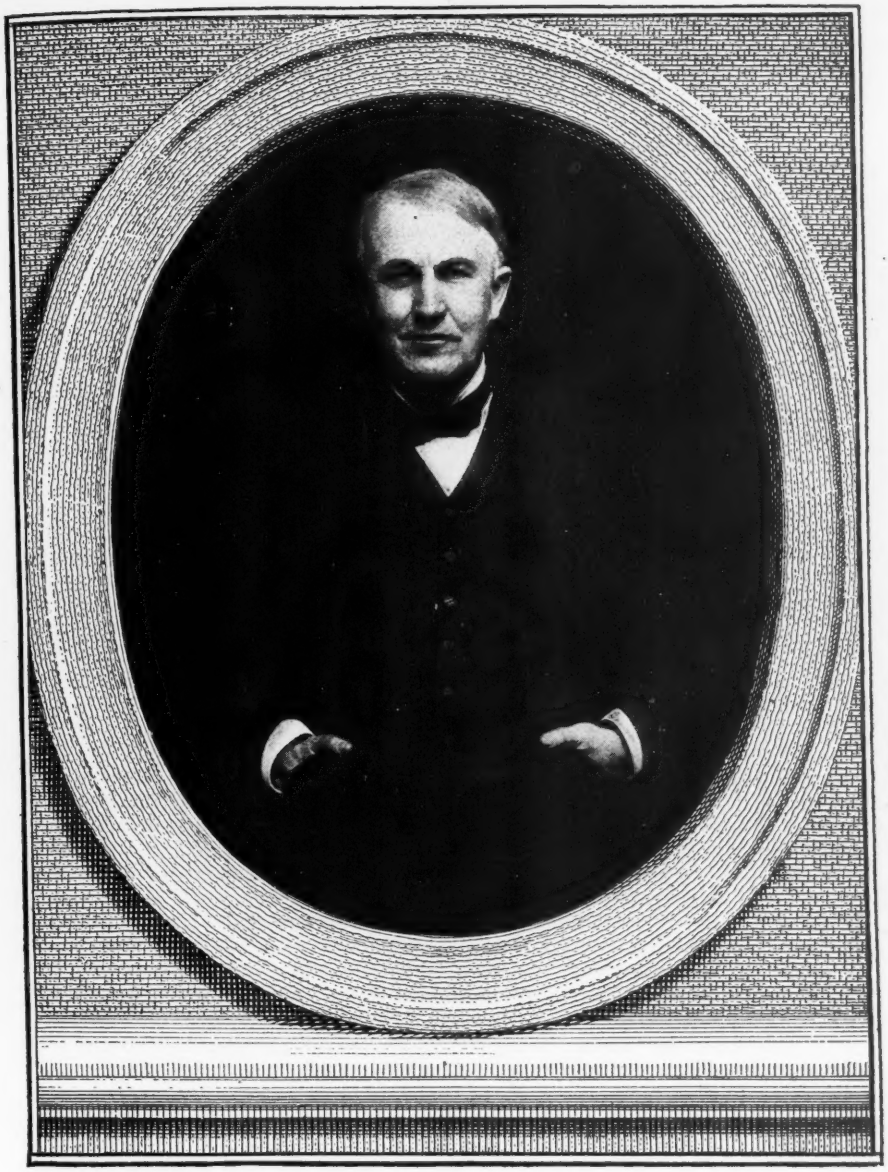

Photo New York Edison Co.

"THE POPULAR SCIENCE MONTHLY is well named, and its mission is being thoroughly carried out by its clear and interesting descriptions of current developments of art and science. It seems to me that the publication should appeal strongly to both technical and lay readers."

Thomas A Edison

Throwing a Torpedo-Proof Wall of Steel Around a Ship

Mr. Flowers plans to protect ships from torpedo attack by means of rapidly rotating disks of steel. A veritable stream of heavy, whirling disks is shot into the water, forming a steel wall. When it strikes a disk, the torpedo will burst. The twenty-five feet of ocean between the whirling disks and the vessel will serve as a cushion, so that the vessel will not be harmed at all

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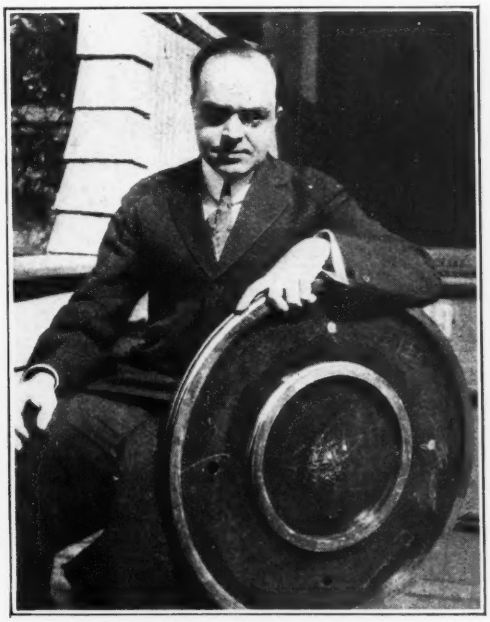
Foiling Torpedoes with Whirling Plates

Hundreds of disks, rapidly rotated, are dropped into the water to act as an impenetrable steel wall

By John B. Flowers, E. E., U. S. Navy

ALTHOUGH hundreds of ships have been sunk by submarines since the war began, practically nothing has been done toward thwarting the torpedo. To be sure, huge nets of steel or of rope have been adopted for the protection of battleships in some navies, but they are of use only when the vessel is anchored. When a ship is under way, they produce an enormous retarding effect. At speeds of six knots and more, they are literally torn off.



John B. Flowers, the inventor of the whirling plate system for foiling torpedoes

Investigations which I have conducted in an experimental tank of great dimensions have convinced me that it is feasible to protect ships from torpedo attack by means of rapidly rotating disks of steel. If a flat disk spins fast enough, its centrifugal force will keep it in one plane. These disks are made up of a metal and a wood plate screwed together so they sink very, very slowly. Another kind of disk is all steel with a hollow air-filled interior. This also sinks very, very slowly. Either kind may be used. If, then, it were possible to pour over the side of a vessel a large number of whirling disks or plates, they would remain sufficiently long in position to constitute a protecting wall against a torpedo. My steel disks are two inches thick and two feet in diameter. They are built up of one thirty-pound plate and two thin cover plates, which when welded together leave the disk hollow. Forty disks are placed in the magazine of each gun of a launching battery. They are fed one by one towards the rectangular barrel of the gun by a column of compressed air. When nearing the top, a disk is caught by three rotating rollers which are revolved by an electric motor. A speed of no less than two thousand revolutions per minute is thus given the disk, and the

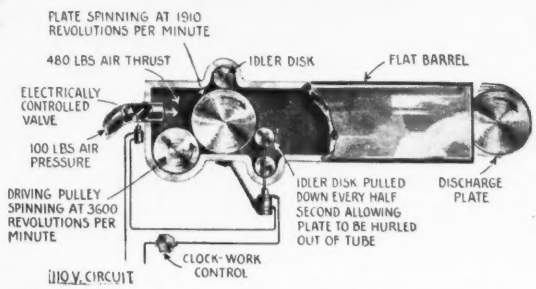


PLATE SPINNING AT 1910 REVOLUTIONS PER MINUTE
480 LBS AIR THRUST
IDLER DISK
FLAT BARREL
ELECTRICALLY CONTROLLED VALVE
100 LBS AIR PRESSURE
DRIVING PULLEY SPINNING AT 3600 REVOLUTIONS PER MINUTE
IDLER DISK PULLED DOWN EVERY HALF SECOND ALLOWING PLATE TO BE HURLED OUT OF TUBE
DISCHARGE PLATE
110 V. CIRCUIT
CLOCK-WORK CONTROL

How the disks are revolved and shot out of the launching gun. There are forty disks to each gun

disk is then ejected from the barrel by highly compressed air or black powder which pushes against the disk with a pressure of nearly fifty thousand pounds. When the idler disk is pulled down by a magnet, the disk is shot out of the gun with the ones beside it nearly vertically.

An electric timing circuit automatically controls the firing. The mere pressing of a button starts a control-clock turning, and the compressed-air valves and the idler-disk release are electrically operated in their turn. As soon as one disk is fired, compressed air brings up another in its place. The one clock is connected with the controlling mechanism of each gun in a battery. A veritable sheet of heavy whirling disks is shot into the water as the guns are fired simultaneously.

Torpedoes can be sighted when from one to two thousand feet from a ship. The time consumed in the torpedo's travel makes it a simple matter to aim a battery of my guns in its path. The steady stream of disks ten times two feet wide, is as easily fired in the path of the torpedo as if it were a stream of water from a hose. The rapid whirling of the disks at high speed prevents them from turning out of the initial, practically vertical, plane. Therefore they begin to sink in the water in their vertical direction, and the buoyancy of the disks caused by their hollow interior prevents their sinking fast. A great sheet of rotating disks is formed in the water which is as formidable as if it were a steel wall. Striking one of the disks, the torpedo will burst. That will be all. The twenty-five feet of ocean between it and the vessel will serve as a cushion, so the vessel will not be harmed.

Evening World Daily Magazine
Waiting for His Contribution By J. H. Cassel
ALLIES PEACE TERMS
WAR RELIEF
How to Win With What You Have Told by C. M. Schwab

At top: John Cassel, the editorial cartoonist of the New York World, draws his Uncle Sam from a cast molded by himself. Below: The finished cartoon

Drawing Uncle Sam, the Figure that Makes or Breaks a Cartoonist

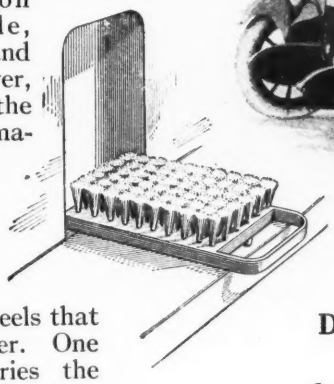
THE ambition of every newspaper cartoonist is to win praise for his figure of Uncle Sam. Indeed, some cartoonists may be said to hold their jobs because of their inimitable characterizations of this venerable and virile gentleman.

Who would not recognize an Uncle Sam by Robert Carter, of the Evening Sun, of New York, or an Uncle Sam by John T. McCutcheon, of the Chicago Tribune, or the same figure by Oscar Cesare, now of the New York Evening Post? If these three cartoonists drew nothing but Uncle Sams they would still have the wide following that they now have. Although the three figures are as different as the cartoonists themselves, they represent in body contour and facial expression all that is distinctly American.

The name of John Cassel, of the New York World, should be linked with the three cartoonists mentioned above. His Uncle Sam is a striking characterization, and not, as one editor remarked, "a hayseed in a gentleman's clothes." The illustration above shows how Mr. Cassel draws his figure from a plaster cast, in order to obtain an accurate representation. The cast was molded from an original cartoon of Uncle Sam by Mr. Cassel, and by drawing direct from it he can not fail to get the expression and atmosphere that belong to his productions alone.

An Automatic Map-Maker. It Surveys by Wagon Jolts

THE photograph at the bottom of the page shows a map-making machine. It is the invention of Theodore Bodde, Westfield, N. J., and F. E. Austin, Hanover, N. H. A shaft at the forward end of the machine is belted to a pulley attached to the hub of the rear wheel. This shaft is geared to a rod on which are mounted beveled wheels that rotate the map paper. One of the boards carries the drawing paper. A spring-supported pencil is arranged to mark on the paper as the wagon proceeds. When a map line has been drawn completely across the paper an alarm bell is automatically rung to warn the operator to shift the mechanism into position for making another map. So long as the machine or wagon is traveling on a level road both disks are stationary and only a straight map line is marked on the paper as it is moved past the pencil point. But when the wagon turns a corner, a set of gyroscopes geared together are arranged to turn the map board so that the map paper is also turned relatively to the pencil point, thus indicating the turn of the road by a deviation in the line marked on the paper. Any error in the marking that would naturally occur through an up-grade in the road is automatically corrected on the map by a pendulum attachment which regulates the rectilinear motion of the map paper so that it is always in proportion to the horizontal length of the road. The machine shown has been put to actual use with entire success. The inventor claims that it is more reliable than the ordinary method.



Scrape the bottoms of your shoes on the little iron bar and then wipe them on the mat before entering the automobile

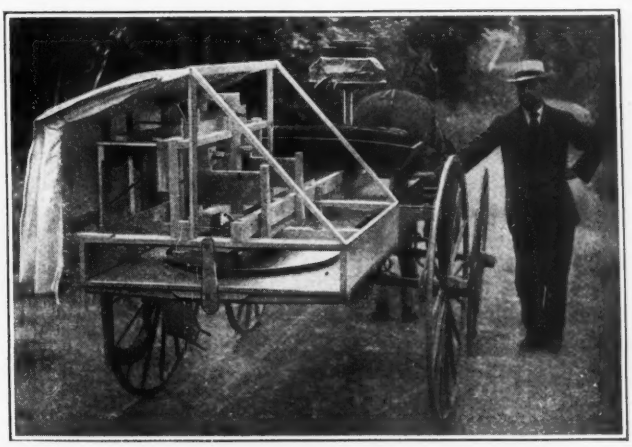
Don't Soil Your Car Floor—Wipe Your Feet at the Door

A SIMPLE but effective way of preventing muddy shoes from soiling the interior of an automobile has lately been brought out by William A. Roos, of New York city. It consists of a small square mat, with a short iron bar in front, which can be brought down flat on the running-board for use. The mat is made up of a number of short stiff bristles.

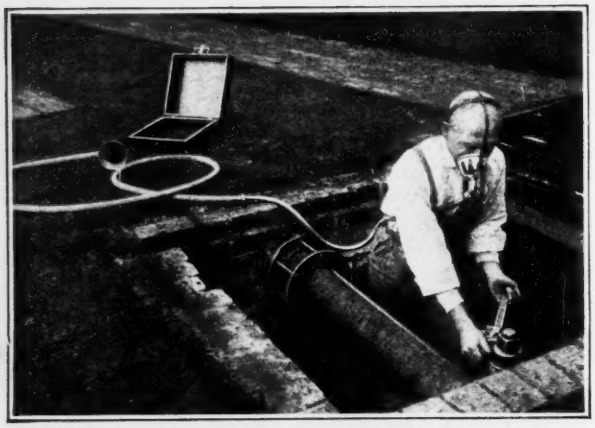
The bottoms of the shoes are scraped over the front iron bar, which projects over the edge of the running-board as shown, so the mud drops down to the ground. The dirt still remaining on the shoes can be removed by the bristles of the mat.

The device folds back into a pocket after it has been used. The last person entering the automobile catches the bottom of the bar with the toe of his shoe and swings it up. Catches on the hinges then hold the device close against the vertical side of the running-board of the car.

The back of the mat is enameled and finished in such a way that it is not noticeable as a separate device when folded back into its pocket. The floor of the automobile will thus be kept tidy and more comfortable in damp or sloppy weather.



The wagon carries a revolving map paper and a spring-suspended pencil which records the lines of the road



The protector consists of a mask, flexible tubing, intake funnel and head straps. It supplies fresh air without any pressure furnished by machinery

Breathing Fresh Air in a Manhole through a Protector Mask

A WESTERN manufacturer has put a gas protector on the market which is designed to enable a man to breathe pure air without pressure while he is working in a manhole repairing gas pipes or wire conduits. It has several distinctly novel features. The pure air is drawn through the intake funnel and tubing fastened over the mouth and nostrils, and the used air is expelled through an exhaling valve.

The protector weighs but seven ounces. The mask is constructed of rubber and aluminum. Adjustable head straps hold it firmly in place and make an air-tight fit, as the rim of the rubber mask is inflated through an air valve blown up by the mouth each time a breath is taken. The flexible tubing is twelve feet long and is equipped with an intake funnel at its end.

A Money-Making Idea! Grow Potatoes in Window-Boxes

IN view of the shortage of potatoes and onions in America, and of the difficulty in supplying the demand for table use, the question of seed potatoes is a serious one. The following plan has been adopted by some thrifty housewives to increase not only their individual supply of potatoes but their pin money accounts as well by providing some for marketing.

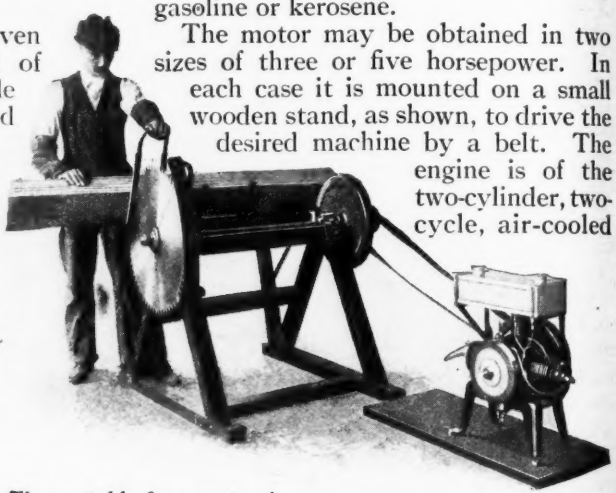
From each batch of potatoes prepared for cooking, a piece from the "rose" end (the end where most of the eyes are) is cut off before peeling. Each piece should weigh not less than one and one-half ounce. These pieces are planted in shallow window boxes in leaf mold, coconut fiber or sand. The boxes are kept in the window of a cool but frost-proof room and the sprouts are grown in them until they are from one-half to one inch high. Then they are planted as seed potatoes.

To prevent the cut pieces from shriveling before they are planted, the cut surface is dusted over with dry, powdery plaster of Paris, dry slaked lime, or finely powdered charcoal. The rose end of the potatoes is hardly missed, and the seed potatoes are thus obtained at a scarcely appreciable cost.

Portable Saw and Pump Outfits for Farm Use

OF great utility about the farm is the small motor and stand shown in the accompanying illustration. It can be carried about in a wheelbarrow and may be used to saw wood, operate a pump, washing machine, churn or even to charge a storage-battery. Its usefulness is further enhanced by the fact that it can be run on either gasoline or kerosene.

The motor may be obtained in two sizes of three or five horsepower. In each case it is mounted on a small wooden stand, as shown, to drive the desired machine by a belt. The engine is of the two-cylinder, two-cycle, air-cooled type, fitted with a high-tension magneto built in the flywheel. It has a standard type carburetor and an integral fuel tank and muffler. A gallon of gasoline will furnish enough power to saw a supply of fire wood that will last for a week, and in an hour sufficient corn can be ground to feed a well-stocked farmyard.



The portable farm motor is run on either gasoline or kerosene

New York City's Indoor Golf Course

It is played with stove-pipes, bricks, barrels and rugs in the rooms of a downtown club

Indoor golf is played without the aid of caddies. No balls are lost, and no golf suits are worn. Nine holes of the course are laid out in the assembly room of the club and nine in the gymnasium

WITH steam heat and elevators, indirect lighting to take the place of sunshine, and art works on the walls to compensate for the lack of landscape, New York enjoys its game of golf in a luxurious club or hotel. This was demonstrated during the winter when the rooms of the Telephone Club were the scene of a spirited contest, with ninety-one entrants, playing for a silver loving cup and other valuable prizes over an eighteen-hole course.

The players start in the Assembly Room with a shot over the polished floor to the edge of the rug. It is not so easy as it seems; for the ball must be in position for a shot through a stove pipe elbow to the hole. Hole 2 is on the edge of the rug, with a neat little barricade of bricks about it in a semicircle, with a small opening. To make the approach to the third hole difficult, bricks are placed under the rug about the hole to make a lumpy surface that sends the ball rolling erratically. The fourth hole is placed on an incline so that the ball glides back unless it is skilfully played.

A carom against a pillar is involved in making hole number 5. Hole 6 is entered through a length of straight stove pipe. Now you tackle a wooden incline with a four inch hole in order to reach No. 7.

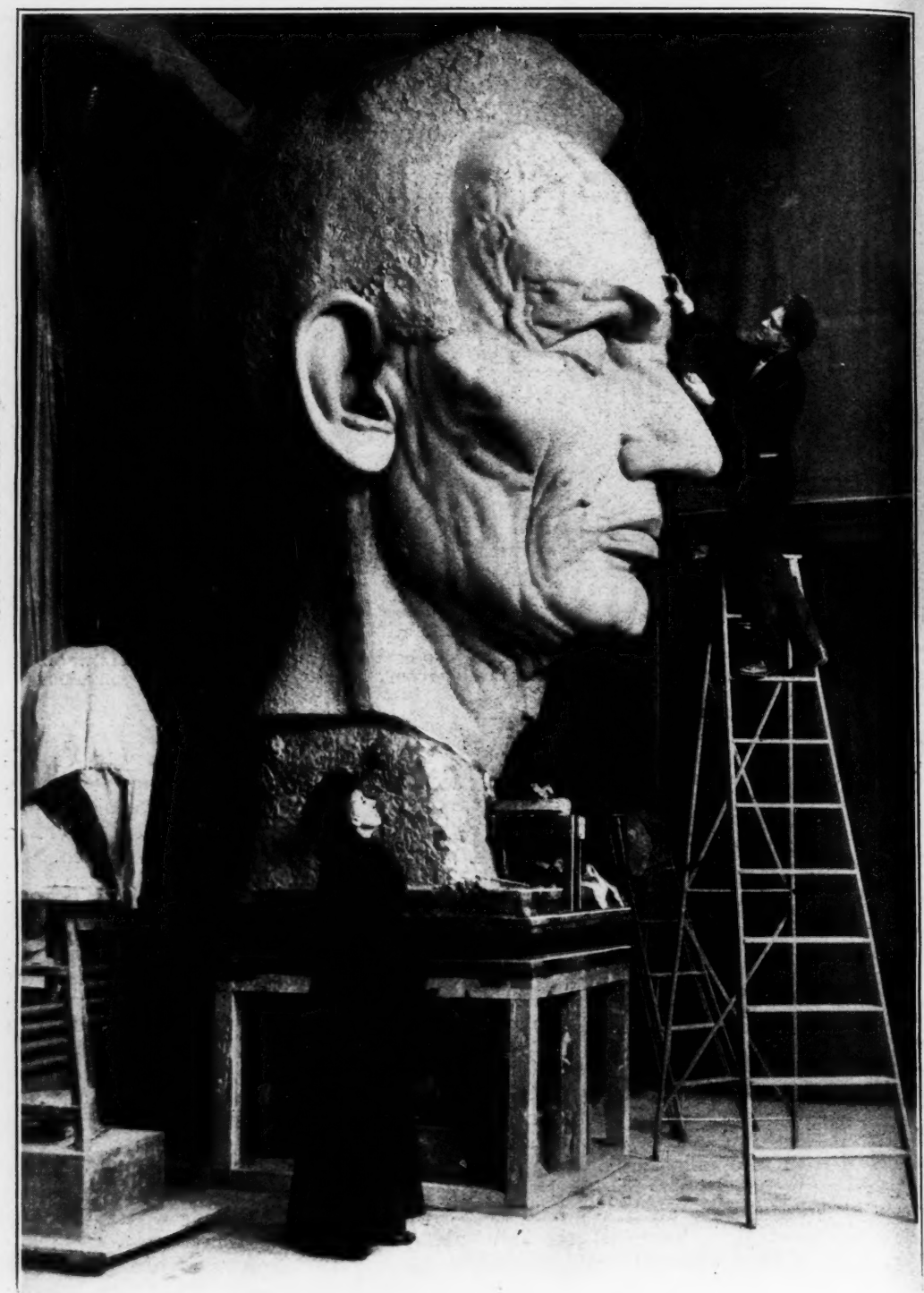
Hole 8 is a typical side-hill putt proposition, with a cup set at an upward angle. For hole 9 a shot is made through an open doorway to an antechamber, where a woven-grass rug provides a fast green.

This concludes the course in the Assembly Room. Now come the nine holes in the gymnasium, where hole number 10 is next attempted through a three-way device, which is likely to send the ball far afield if not carefully handled. After a carom to hole 11, the twelfth hole is played up a carpet runner from the floor to the stage. The unlucky number which follows involves a shot down from the stage and up another incline to a level spot.

After this, hole 14, which is completely surrounded with bricks and requires the use of a mashie, seems not so difficult.

Hole 15 involves simply a straight shot along a runner to a hole on a raised platform. Sixteen is a relief to the tired golfer—a straight hole, without obstacles or concealed traps. On hole 17 are three bunkers, the hole being located between second and third. As a grand finale comes hole 18—a barrel hung from the ceiling. For this a mashie and three trials are allowed.

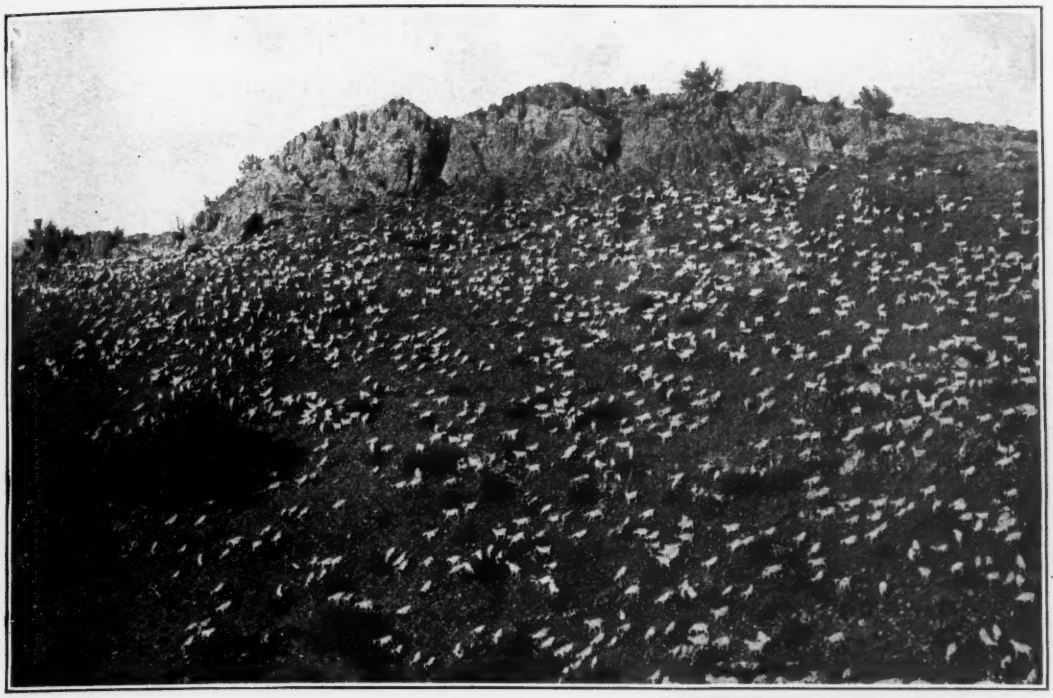
This Head of Lincoln Seems Almost Flesh and Bone



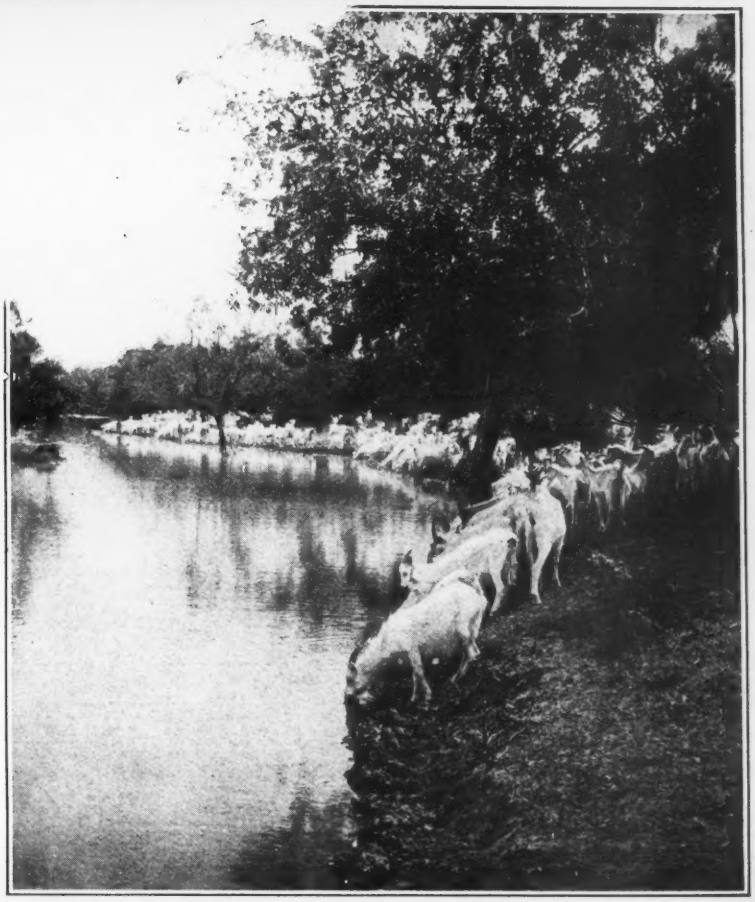
© Underwood and Underwood, N. Y.

George Barnard working on his statue of Lincoln's head. The lady watching him is Miss Ida Tarbell, the magazine writer and author of a life of Lincoln. Of Barnard's statue Miss Tarbell says: "It is the profoundest thing yet done on the man. Barnard has studied Volk's wonderful life mask until he knows every wrinkle, every growth, every ridge in the gnarled and furrowed face." The statue is fifteen feet high. Study it a moment and its trueness will be apparent

Raising Goats on a Diet of Prickly-Pear and Scrub-Oak



A herd of angora goats feeding upon a Government scrub-oak range in Arizona. Goats are notorious for their digestive apparatus, eating everything, apparently, except rocks. For this reason they play havoc with a cattle range but clear out scrub-oak thickets



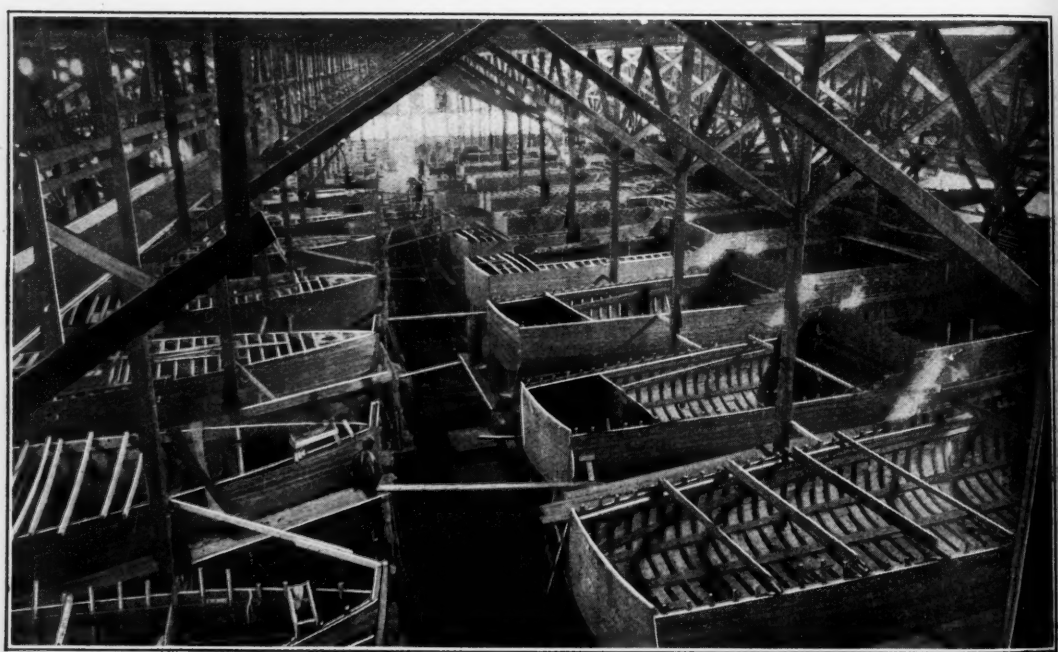
A herd of healthy angoras coming down to a watering place for their daily drink at Eagle Pass, Texas. They have been grazing in prickly-pear thickets. It takes about four acres to feed a goat, according to a Government investigation record

The Swarm of Submarine Chasers Which Is Being Built

© Press Illustrating Serv.

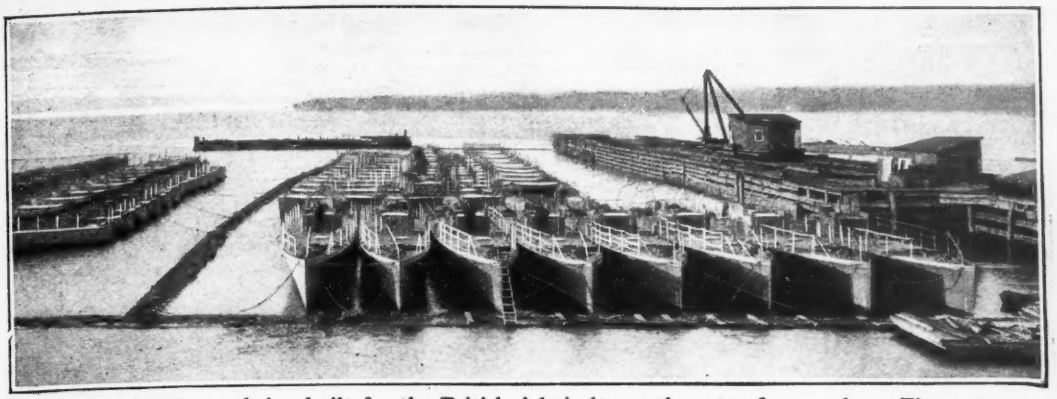
Above: A submarine chaser of the latest type. It draws but thirty inches of water; A torpedo travels at a depth of from eight to fifteen feet. The boat's speed is more than forty miles an hour. It carries two guns

Below: An entire shipbuilding plant works day and night turning out these chasers for the British. Each boat is manned by eight men and the cruising radius is fifteen hundred miles on one thousand gallons of gasoline

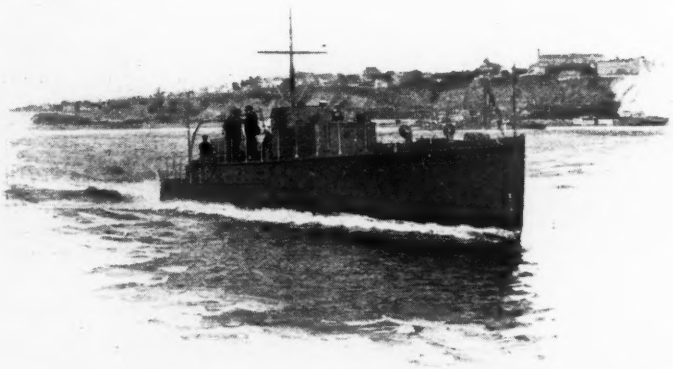


© Int. Film Serv.

to Save English Shipping from the Ravages of U-Boats



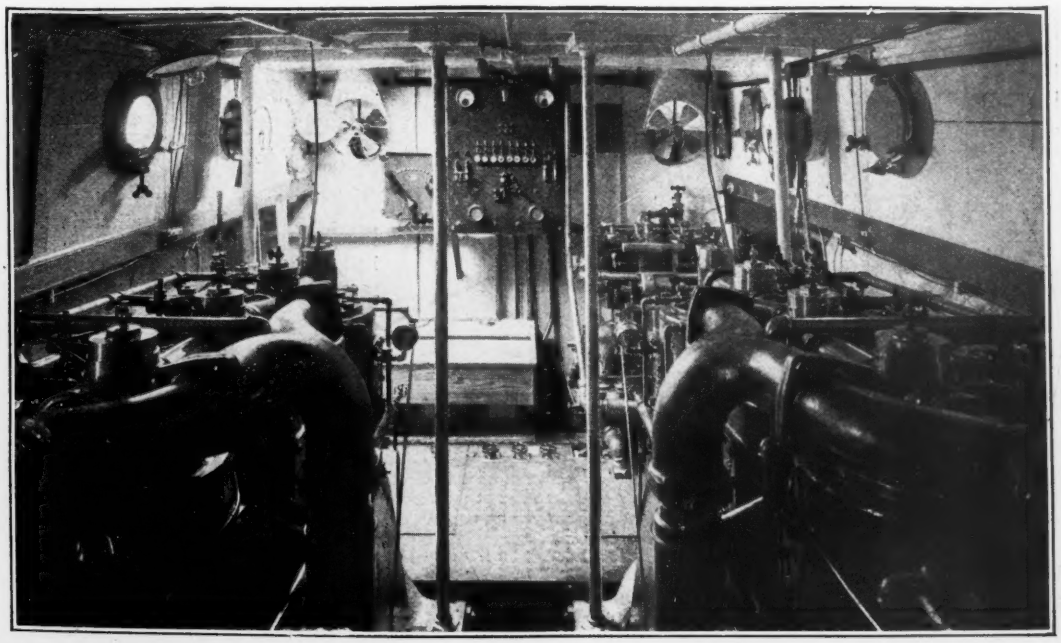
Submarine chasers being built for the British Admiralty at the rate of one a day. These sea-wasps have done yeoman service in the anti-submarine crusade. They are said to have assisted directly in the loss or capture of literally scores of submarines belonging to the enemy



The submarine chaser is eighty feet long, with a twelve-foot beam. The cruising radius is seven hundred miles at twenty-two miles per hour and fifteen hundred miles at fourteen miles per hour

The motors are of five hundred horsepower and the sea-keeping qualities are such as to allow for a sea patrol of ten days duration. The English channel is regularly patrolled by these boats

Photos © Int. Film Serv.



Violets Wasting Their Sweetness on the Desert Air

Violets? Acres and acres of them going to seed in the California autumn. There are sweet violets, marsh violets, hairy violets, dog violets and mountain violets all growing in the same field, which is at Coma, California

Milady can visit the fields at any time she wishes and pick her own flowers. Violets are prodigious seed-yielders in the autumn, while the more conspicuous spring flowers with which we are familiar yield little or no seed

Rearing Snakes for the Venom They Yield

© Newman Traveltalks and Brown & Dawson

At top: The death struggle between a poisonous and a non-poisonous snake. The coils are exerting a crushing force and the fangs of the crushed one are at the other's throat

At top: Dr. Vital Brazil extracting the venom from a poisonous snake. The poison sacs of the snake are pressed, forcing the angry reptile to eject the venom from the fangs

Dr. Brazil on his snake farm at Sao Paulo, Brazil. The snakes are raised for the poison which they yield. This is in turn used as an antitoxin for different diseases, including snakebite itself

War Pictures of Monastir Under Bombardment by

© Amer. Press Assoc.

The city of Monastir after its capture by German-Bulgarian forces. A French aviator snapped the pictures from his war machine. On the outskirts of the city is a network of trenches, shown by the black lines, from which the defending troops were driven out. The black streak across the photograph represents the railroad

Germans and Bulgarians, Taken by a French Aviator

Monastir in the throes of the fierce bombardment. The city was a rich prize for the Central Powers. The white splotches in the picture represent smoke rising from the burning buildings, military stores and granaries set on fire by bursting shells. This is one of the few photographs taken during the war showing a city actually under bombardment

Chickens—Chesty and Otherwise

© Amer. Press Assoc.

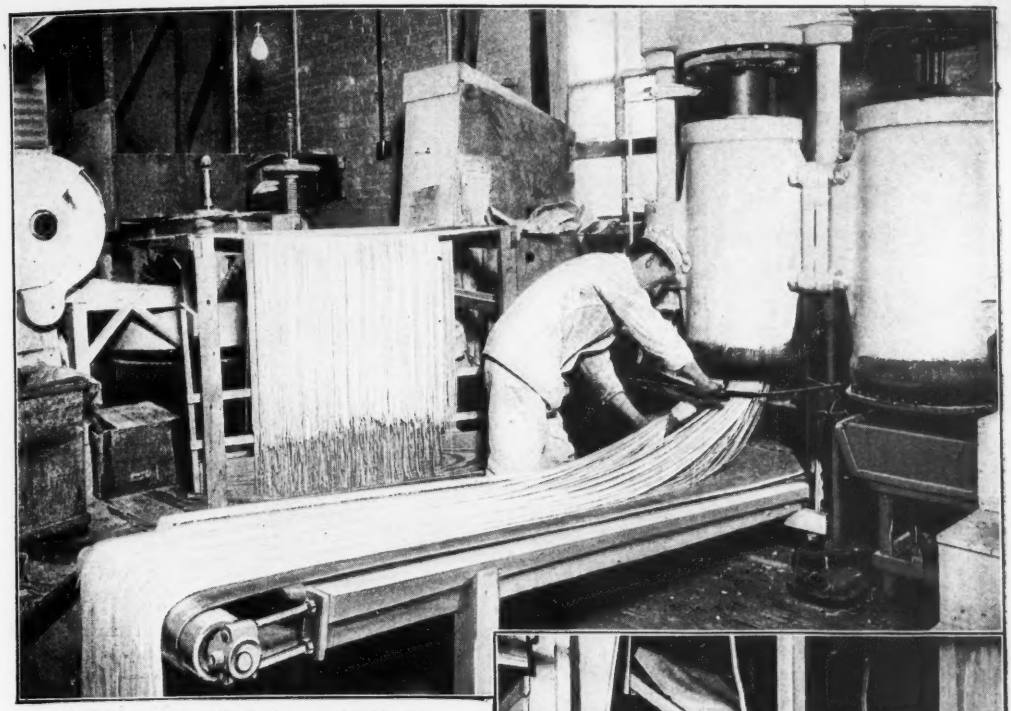
In circle above: A four-legged chicken, the mascot of the steamer Carrillo. The extra pair of legs hang uselessly behind the good pair curled up like an odd kind of quills. The chicken was presented to the Carrillo's captain at a South American port

One of the feathered wonders of the Far East—a Japanese rooster with a twelve-foot tail. The Japanese take particular delight in raising these fowls, which require careful feeding and constant attention and cleaning

At left: Not a pouter pigeon, but the champion chest-expanding chicken of the world, living at La Paz, in Bolivia, at an altitude of thirteen thousand feet. Because of the high altitude the chicken's chest is over developed

Newman Travel-talks and Brown & Dawson

This Is How the Slippery Spaghetti Is Made



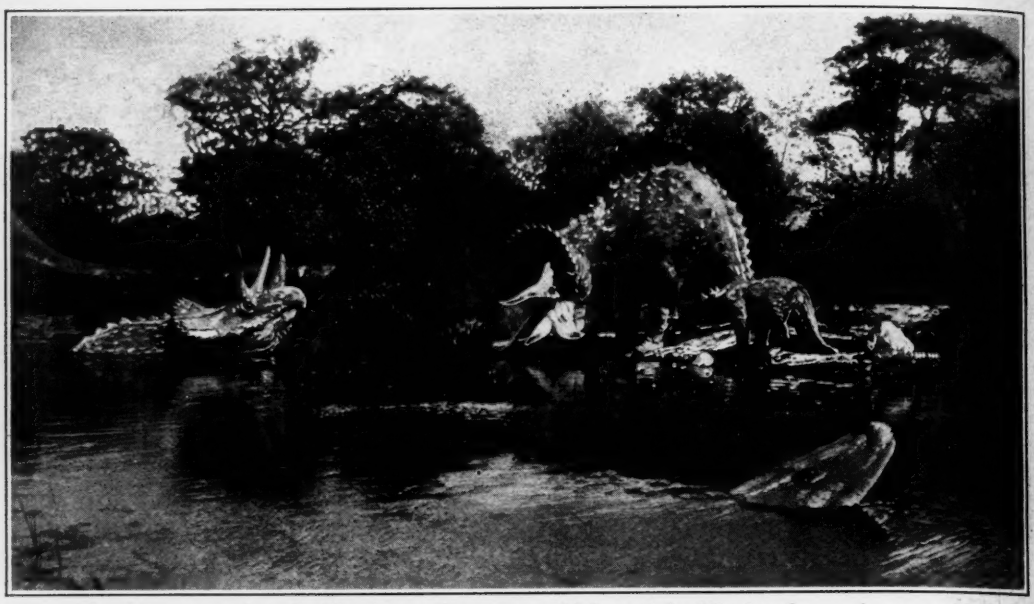
Spaghetti naturally belongs with Italian skies, but it is now made in great quantities in the United States. It is made of wheat paste, which is forced from cylinders, in long slender tubes

© Press Illus. Serv.

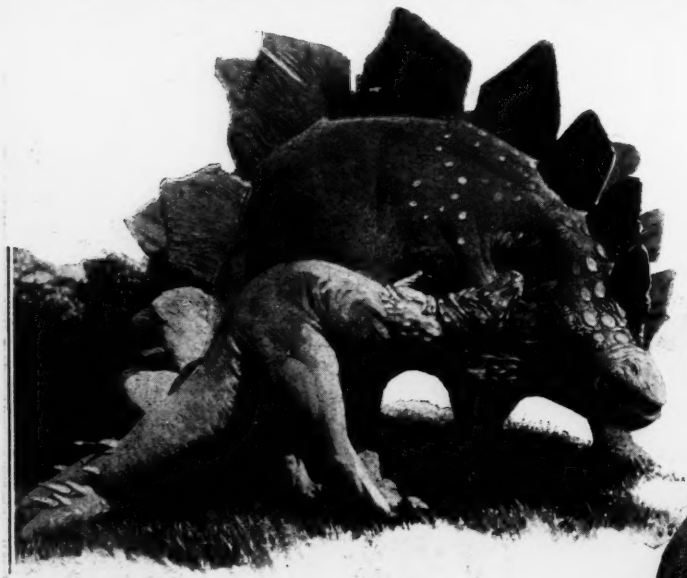
The tubes are hung over frames to dry, care being taken that they do not touch each other. In modern plants the work is done almost entirely by machinery and the drying by electricity

Above: Noodles are made in much the same way as macaroni and spaghetti except that the paste is first rolled in sheets instead of being molded into tubes. It is then cut into various shapes. The addition of milk and eggs to the ingredients of egg noodles, makes them a more expensive product

In Hamburg, the Monsters which Walked the Earth



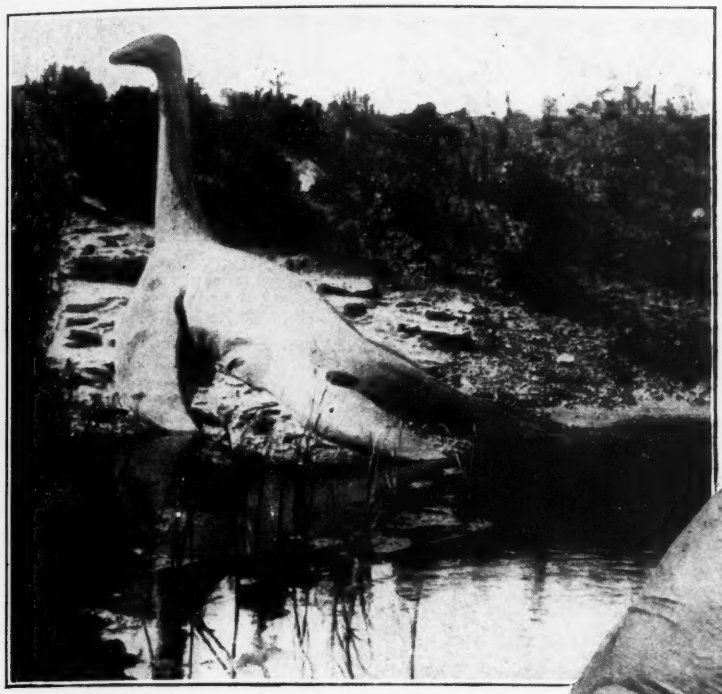
The famous gardens in Hamburg, Germany, which contain life-size figures in concrete of the great sea and land monsters which inhabited the earth millions of years ago. Above is shown a group of marine animals of strange appearance and equally unfamiliar names



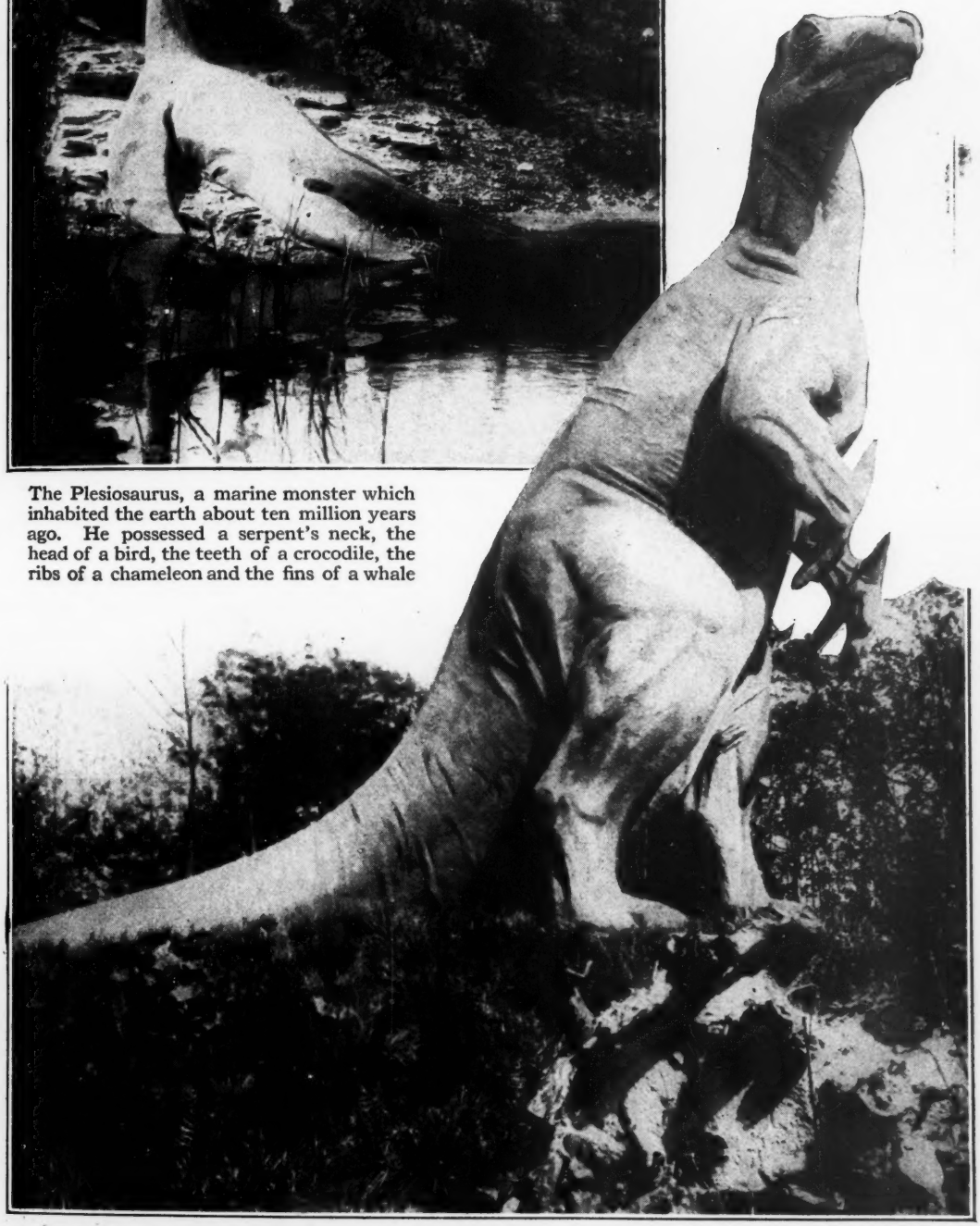
The Stegosaurus, a veritable land dreadnought of prehistoric times. This creature carried a double row of blades or spines down its back. It was twenty-five feet long. More than twenty complete specimens have been found in the neighborhood of the Rocky Mountains

The Tyrannosaurus, the largest flesh-eating animal that inhabited the earth. His bones have been found intact in the Bad Lands of Wyoming and in the sandstone district of Alberta, Canada. When the present Rocky Mountain district was a vast swamp the Tyrannosaurus reigned there supreme and unchallenged

in Prehistoric Times Are Re-Created in Concrete

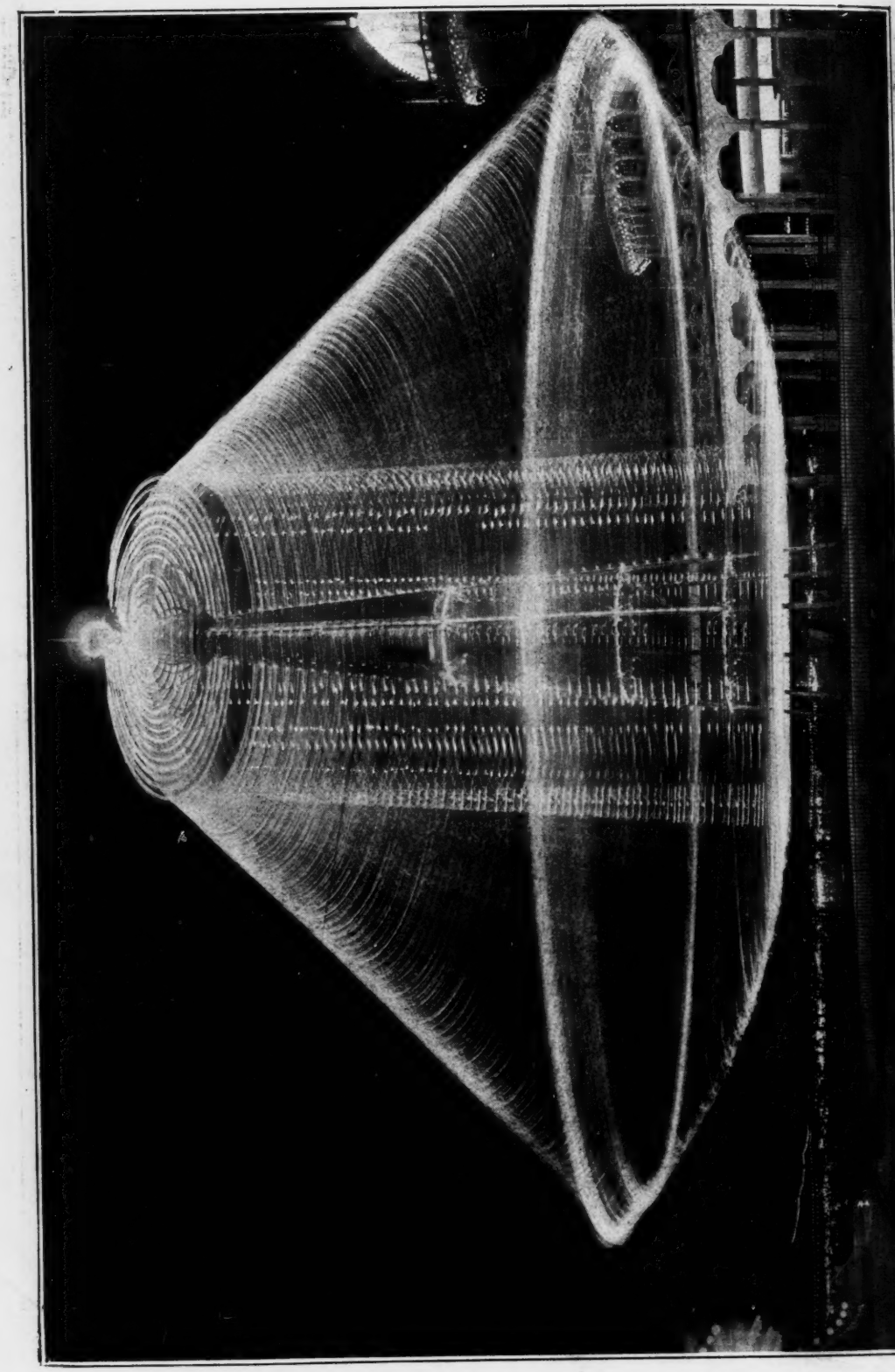


The Plesiosaurus, a marine monster which inhabited the earth about ten million years ago. He possessed a serpent's neck, the head of a bird, the teeth of a crocodile, the ribs of a chameleon and the fins of a whale



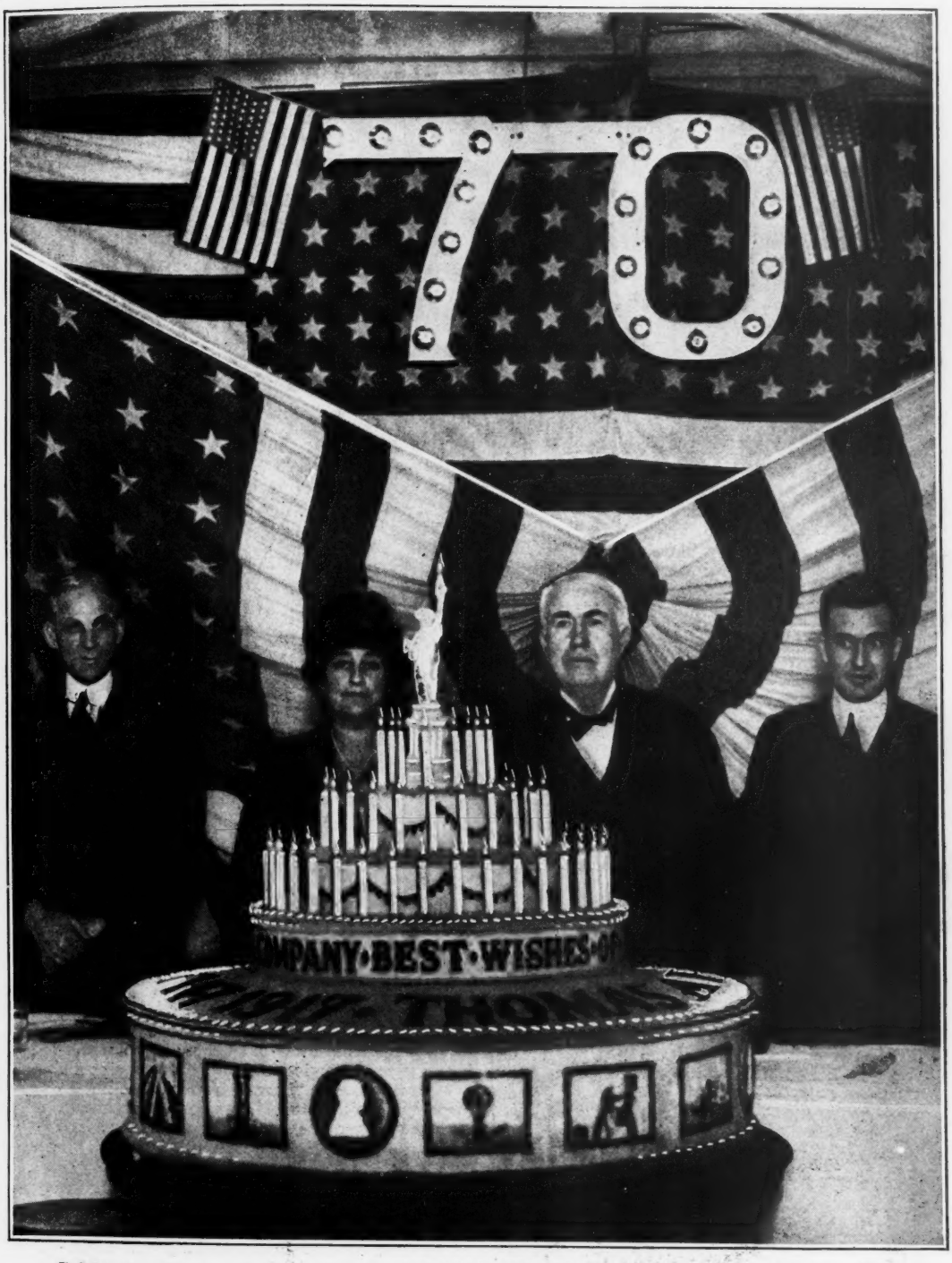
The Iguanodon, a dinosaur that reminds one of the kangaroo. Every bone of the monster's body has been found in Belgium and England and cast in plaster. The fore limbs were comparatively small, the large three-toed hind limbs being chiefly used in walking and jumping

Like a Spinning Top Hung from the Sky



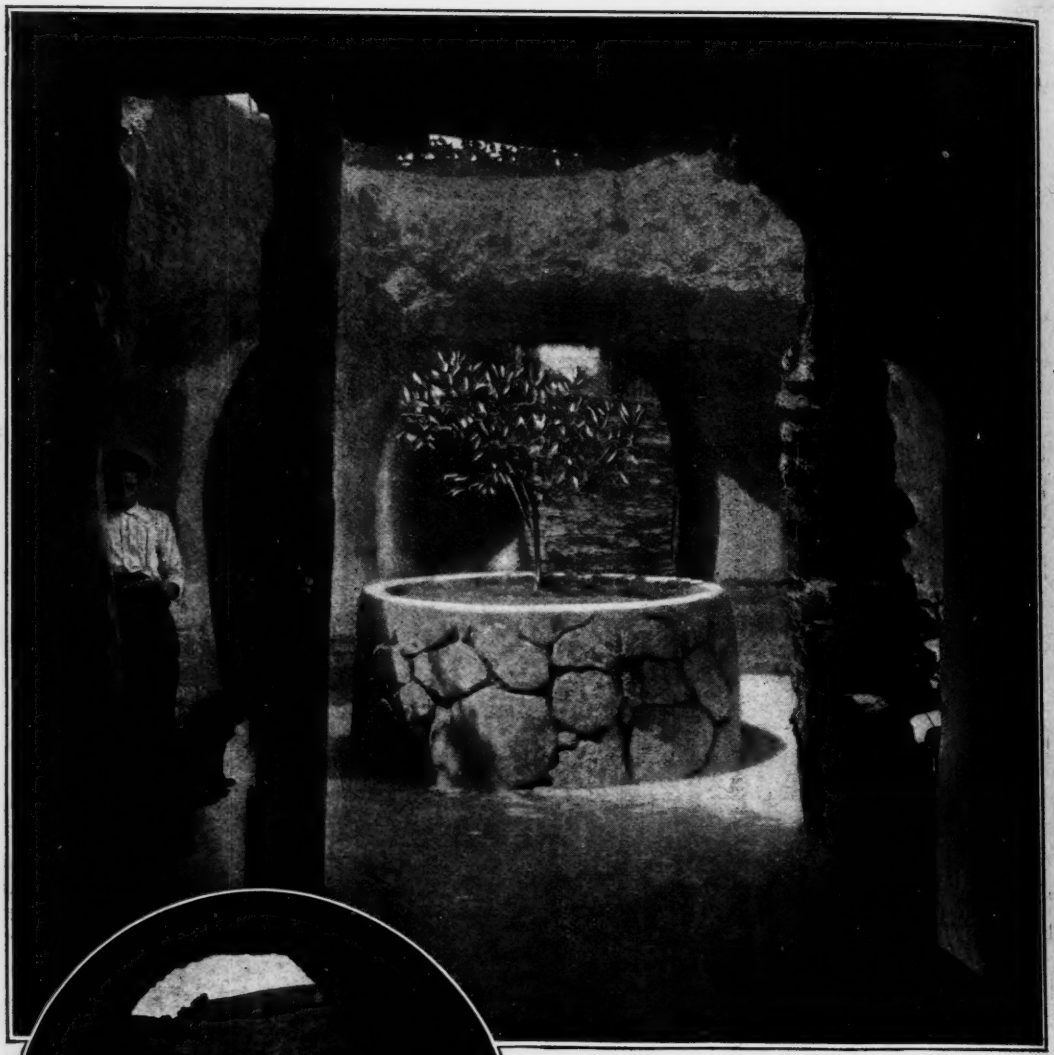
Not a futurist drawing, but a bona fide photograph of an electrically-lighted swing. It is the result of a fifteen minutes' exposure on the part of the photographer, during which time the swing revolved at increasing speed around its pivot tower producing circular outlines on the plate

Our Greatest Inventor Is Three Score Years and Ten

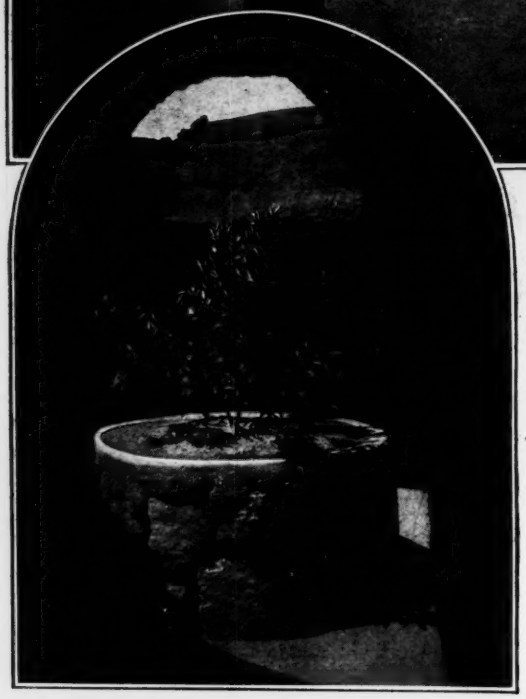


Celebrating Thomas A. Edison's seventieth birthday at his West Orange, N. J., factory. From left to right are Henry Ford, Mrs. Edison, Mr. Edison, and Charles Edison, the inventor's son. Beginning work at the age of twelve, as a newsboy on the Grand Trunk line running to Detroit, Mr. Edison owes all his distinction and advancement to himself alone. He has taken out more than a thousand patents. His greatest invention is the incandescent lamp, which has turned night into day, and which has given five million people their living, directly or indirectly

An Underground Summer Home Hewn out of



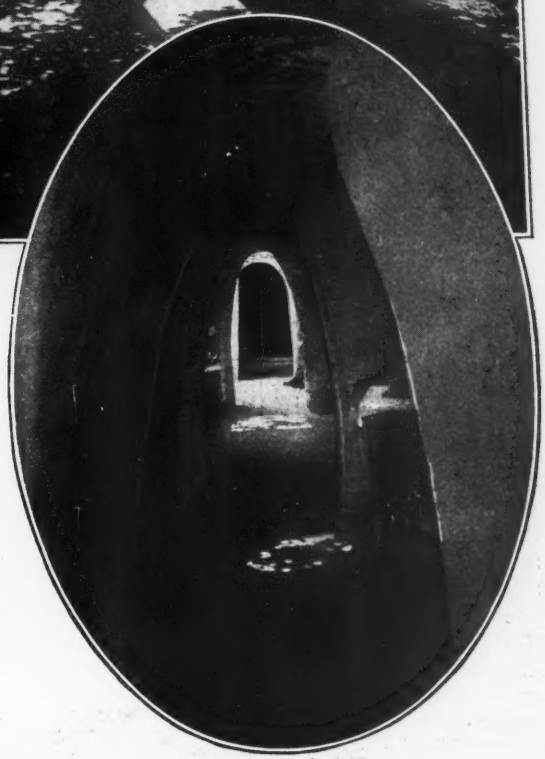
About seven miles north of Fresno, California, an enterprising citizen has constructed a novel summer home underground. It is dug out of rock, locally designated as "hard pan," which is impervious to moisture. In the picture above, the owner is shown in the entrance hall



A near view of the entrance. It is fourteen feet below the surface. There are sixteen rooms in all, honeycombing an underground area of half an acre. Most of the rooms have glass ceilings with provisions for ventilation. A young orange tree in first bloom graces the outer door-way

the Rock Beneath the Above-Ground Residence

The approach to the underground dwelling is through a long grape arbor, sloping gently down to the entrance, which is about fourteen feet below the surface. Here the bachelor receives his friends. The corridor is about eight feet wide and extends back about two hundred feet



At right: One of the two lateral tunnels between the rooms. These tunnels are seven feet high and about three and one half feet wide. Every twenty-five feet there is a room which opens to the surface for light and ventilation. At the end of this tunnel are the kitchen and pantry

At the approach of poison gas in the trenches a klaxon horn is sounded

A "Honk! Honk!" in the Trenches Means "Don Your Gas Masks!"

THE deadly gases which have been introduced into trench warfare as the equal if not the superior of exploding shrapnel for exterminating an enemy, have necessitated the use of various kinds of gas masks, many of which have proved effective. But it is inconvenient for the soldiers to wear the masks constantly. So, various mechanical devices have been used to give the alarm of approaching poison gas to enable the troops to put on the masks in time to avoid danger.

In a French trench the klaxon horn, shown in the accompanying photograph is used for the purpose, which gives an altogether new meaning to the familiar "honk." The masks are kept within instant reach, and so readily are they adjusted that when the alarm is heard the soldiers almost immediately become unrecognizable under them and correspondingly safe.

Massaging the Digestive Organs by Deep Breathing

PHYSICIANS agree that massaging the abdominal organs is at best a delicate procedure requiring the skill of a professional in order to prevent more harm than good being done. And yet abdominal massage is recommended as a help or cure for various ills, especially for constipation. A method which is so gentle that no baneful effects could possibly result employs systematic deep breathing as the agent.

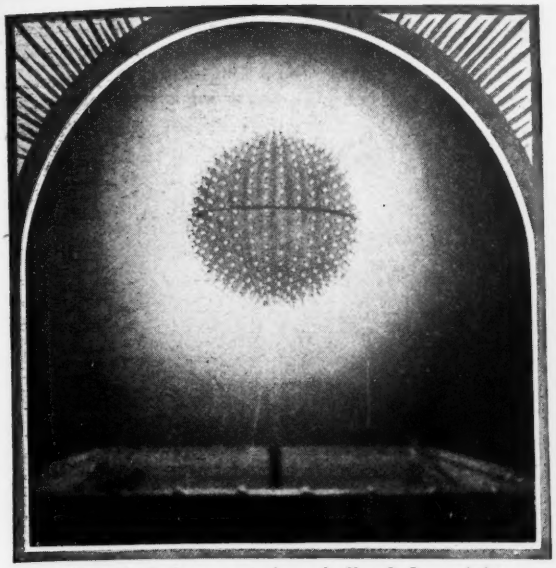
The diaphragm and the muscles of the abdomen share in the work of respiration and at the same time press rhythmically upon the intestines. In order to increase the pressure so that massaging of the intestines results, it is only necessary to breathe more deeply than is customary and to keep it up rhythmically. The patient should lie face downward across the bed taking from five to seven deep breaths a minute. A pillow under the abdomen serves to press the organs in so that the force of the breathing is felt more by the enclosed organs than by the stretching outer skin.

Railroading in Alaska Is Still Far from Rapid

THE photograph below shows the only method of transportation in the rich gold-bearing Iditarod region of Alaska, and this is probably all they will have for some time to come, although their outlet or connection is now a real railroad line instead of uncertain water transportation as formerly. Gold was discovered there about six years ago with the usual resultant rush of miners and prospectors.

The present railroad consists simply of short poles for ties, laid on the mossy surface of the ground, without ballast, and rails of sawed wood; but on it a tandem of stout horses with one driver can haul a tram car containing as much merchandise as was formerly carried by a pack train of twenty animals.

The transportation system which a gold-bearing district in Alaska boasts. The track is composed of wooden poles



Toledo's baby moon is a ball of fire, eight feet in diameter. It is an advertising device

Toledo Plants a Baby Moon in the Sky

"LIKE the Moon led astray in the Heaven's wide pathless way," wrote the poet Wordsworth many years ago, without knowing, of course, that in later years some emboldened Toledo folk would actually abduct a young moon and take it to the top of a twenty-two-story skyscraper and fasten it there just for the sake of looking at it.

It goes without saying that Toledo's young moon is for advertising purposes, but the Toledo people get around that easy enough. "Doesn't the real moon advertise the fact that there is a sun on the other side of the world?" they ask. And there you are.

Fifteen miles out on Lake Erie, pilots of steamers can see Toledo's moon. Engineers on trains, passengers, automobilists, and everyone approaching the city, wonder what the big ball of fire is. Everywhere is heard the question, "What is that great light in the sky?"

The baby moon is nothing more than a huge ball eight feet in diameter, lighted with eight hundred seventy-five-watt lamps, equivalent to seventy-five thousand candlepower. To operate the ball eighty horsepower is required. The ball has the appearance of revolving, due to a flasher which turns the current on and off, making the lights quiver. There is no word of advertising on or near the ball.

How the tiny moon looks on a dark night on top of its twenty-two story building

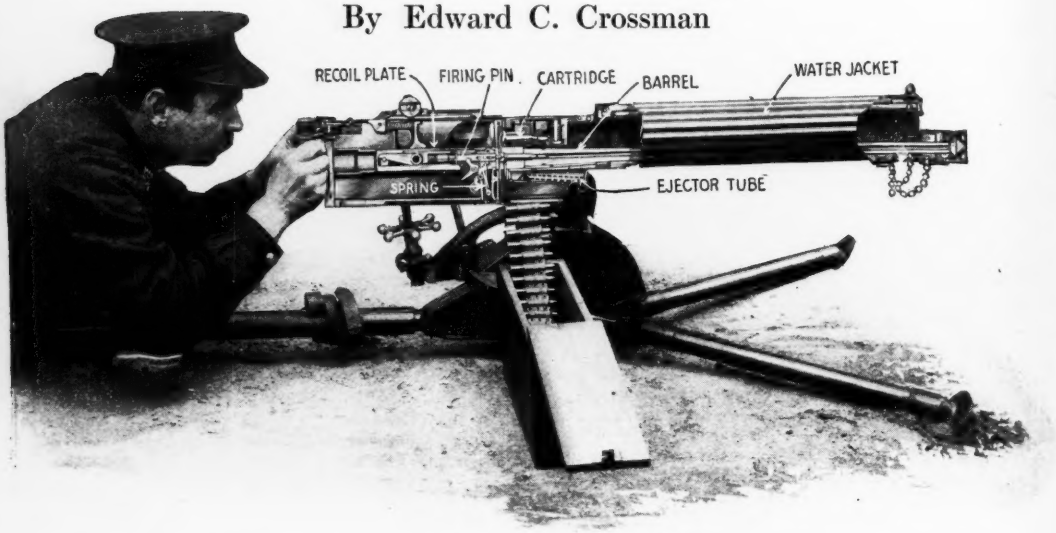
As a Lineman He Has Climbed Eight Hundred Miles

THE next time you see a lineman scaling a telephone pole think of William Lane, of Rockford, Illinois, who has climbed over eight hundred miles in the last twelve years. Mountain climbing pales into insignificance compared with scaling telephone poles. It takes more strength to climb ten feet of pole with spurs and harness than it does to climb five hundred yards of steep mountain side. Lane's average as a lineman has been twenty-five poles a day, or something like one hundred and ten thousand times forty feet. He has had several falls, due to poorly-fastened spurs and harness, but no bad ones, he says.

The Story of the Machine Gun

Peace-loving Americans invented the deadliest of modern weapons

By Edward C. Crossman



The water-jacketed Maxim. The cartridges are fired by means of webbing belts. They fire at the rate of from 300 to 600 shots per minute. No machine gun is fired very long

THE machine gun is purely an American weapon, from the Gatling of black powder days to the latest featherweight Lewis and Hotchkiss and Maxim. It is frankly and brutally a man-killing weapon.

In Civil War days Dr. Gatling of Chicago evolved a seven-barrel gun to fire the army .45 caliber cartridge at the rate of four hundred or five hundred shots a minute. By the grinding of a crank, the seven barrels and the mechanism were revolved around their long axis. A barrel was loaded as it left the top position, the loading and closing of the breech being done on the half revolution from top to bottom position. At the bottom position the cartridge was fired, and on the upward turn the breech was opened, the cartridge extracted and the barrel left ready for the fresh cartridge by the time it came to the top. The operation was the same for each barrel, and the seven spun furiously around and around, spitting fire and death at a rate unheard of in those days. The cartridges were fed from a drum or a hopper above the gun, dropping down for each barrel by the force of gravity into the grip of the loading mechanism. Later an improved feed was designed, the Acles, which fed in cartridges by positive motion, even though the magazine was placed at the side of the gun.

The gun was used at different times in our Civil War but always manned by employees of the Gatling Company. Because of the poor ammunition of those days, the gun was often jammed, but it was extremely successful and formidable with good ammunition, and was the first machine gun of history. Even as late as the fight at San Juan in 1898 the Gatling was used, its fire helping to take the blockhouse on the hill. But our army was always suspicious of the gun, not knowing just how to use it. It was too heavy to accompany infantry, and its range was not long enough to be used with artillery.

The French in 1870 had the same trouble learning what to do with their first machine gun, the mitrailleuse. That frightful weapon was as heavy as a field gun, and looked like one, so the French used it with their batteries in spite of its short range. Then the Prussian long range field guns would knock the mitrailleuse clear over into the next county without having to fear a reply from the faulty infantry cartridges which were its food.

The mitrailleuse—which means merely a "grape-shooter" from the fancied resemblance of the strike of its bullets to the impact of a charge of grape-shot—had thirty-seven barrels mounted in an iron

casing that looked like the barrel of a cannon. The infantry rifle cartridges used were arranged in an iron plate with thirty-seven holes in it, and which formed the breech end of the barrels. The plate carrying the thirty-seven cartridges, was slipped into grooves in the movable breech block, the block was shoved up until the cartridges entered the barrels and the plate fitted snugly at the breech-end of the barrels, and then the thirty-seven shots were fired by the turn of a crank, which released one after the other the little hammers in the block opposite each cartridge. By giving the crank an entire and swift turn, the thirty-seven shots were fired in one second, a slower turn of the crank of course fired the cartridges at a correspondingly slower rate.

© Underwood and Underwood, N.Y.

Army men practicing with a Colt machine gun found in a Sulu store

Because of this peculiar firing rate, the gun had a menacing, growling report, a sort of "Gr-r-rr-ump," that the Prussians quickly learned to identify. After firing, the breech was opened, the plate carrying the thirty-seven empty shells was taken out, and a fresh, filled plate was slipped in the block.

This was the first use of a machine gun in war, and because of the French Army's faulty use of it, little harm was done. It was never so effective as the Gatling.

© Int. Film Serv.

The Maxim is undoubtedly the best known machine gun. It is water-cooled and heavier than others

These guns were not really automatic machine guns; they were operated by hand power, they were heavy, and they were mounted on wheels and exposed to return fire.

The Gardner and the Nordenfelt were more so-called machine guns of hand operated type. Not until the coming of the Maxim did the machine gun become the frightful weapon that it is now.

Following is a list of the modern machine guns:

Maxim, used by England and Germany and Russia—American.

Hotchkiss, used by France and Japan—American.

Benet-Mercié, modification of Hotchkiss—American and French.

Colt, used by Russia and other nations—Browning, an American.

Lewis, used by England and France, an American army officer.

Schwarzlose, used by Austria—German.

Those most commonly used and most efficient are of American design from start to finish. The celebrated "Pom-Pom," used by the Boers against the British, and re-christened because of its peculiar rhythmic pounding noise, was a Maxim-Nordenfelt, firing cartridges six inches long, twenty-five to the belt, and using a one-pound high explosive shell. It was merely a larger machine gun.

The British had little use for the machine gun, save in the navy, where it was used with large caliber bullets of steel to repel torpedo boat attacks prior to the days of modern quick-firing navy guns. But when Kitchener took command in South Africa he carried with him plenty of machine guns—Maxims. At Omdurman, the greatest and most one-sided slaughter of modern times, where spears and courage were pitted against modern arms—the chattering Maxims proved by the piles of savage dead, to be

the most frightful of modern weapons.

But when the Japanese and Russians learned to use machine guns as they should be used—in touch with the infantry at all times, civilized Europe woke up to the possibilities of the chattering demons.

When the great war broke out, the Germans had more than fifty thousand machine guns of Maxim type, aside from those used specially for fortress defence.

The modern machine gun ranges from the automatic rifle form, such as the Lewis and Benet of our service, weapons weighing thirty lbs. or less—to the weightier water-cooled Maxims and kindred guns, such as the Germans use. All of them operate the same way. They fire at the rate of from three hundred to six hundred shots a minute so long as the ammunition supply is kept up—and all of them use the ordinary infantry cartridges of the army operating them. So long as the trigger or firing bar is held back, the gun continues to fire. Most of them can be used as single shots, a shot to each pull of the trigger.

British troops using a Lewis machine gun in the trench fighting in the Balkans. It fires fifty shells

Photos © Int. Film Serv.

A Lewis machine gun taken apart. The magazine (shown in photograph above) is missing

The Colt, Maxim, and Schwarzlose, feed their cartridges by means of webbing belts holding usually two hundred and fifty shells, and refilled by a special machine. As a rule each gun has several thousand rounds of shot loaded in these belts, carried with each gun.

The Benet-Mercié and Hotchkiss of older type, feed their shells through flat clips of steel, holding thirty cartridges in each one.

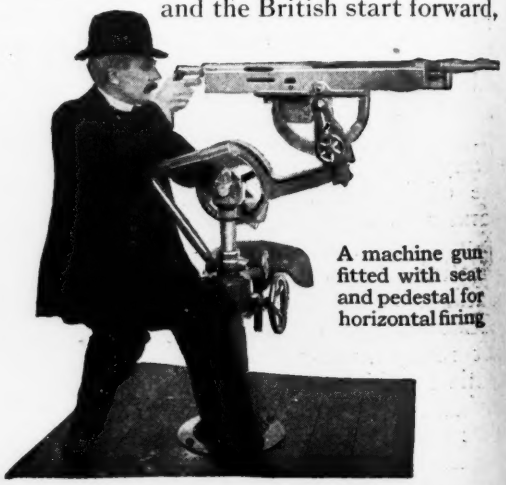
The Lewis feeds by means of a drum of fifty shells, which when emptied can be replaced in an instant with a filled one.

No machine gun is fired continuously. It will not stand it, and the damage is worse when the gun is of the air-cooled variety instead of water-jacketed. The air-cooled gun of Benet type is ruined in five minutes' continuous firing, which means without any more pause than enough to insert filled clips. Each shot develops a temperature of five thousand degrees.

Any of these machine guns, fired until it is good and hot, which does not mean necessarily for five minutes, or more than one, will fire a cartridge inserted into the barrel, from the heat alone. The Colt gun when firing at a lower rate than four hundred shots to the minute, has an unpleasant habit of firing the shell being inserted into the barrel, from the heat and before the action is entirely closed, producing disconcerting effects on the mechanism and gun crew.

Machine gun fire is by short bursts of shots, ten to thirty; then the fire stops and the gunner relays the gun on the mark. The Germans use them in pairs, alternating their fire, one backing up the other in case of a jam.

The German front is solid with machine guns. The British tear to bits their trenches and make a waste of their entanglements, but after the fire has lifted and the British start forward,



A machine gun fitted with seat and pedestal for horizontal firing

out come Hans and Fritz, dragging their Maxims, and then the rest of the crew from their dugout shelters—and the machine guns operated by a little handful of men are likely to win the battle against hundreds of infantrymen.

The machine gun is equivalent to the fire of from fifty to one hundred men, but as the gun is usually mounted on a stationary foundation, especially in the German service, and holds its position, not being affected by nerves or fear, and being worked by cool, desperate, picked men, it is really equal to far more than that number, because of the greater effect of its fire.

© Int. Film Serv.
A machine gun knocked down, ready for transportation. It weighs about seventy-five pounds with its mount

The German Maxim is mounted on a combined tripod and sledge, and with mount and gun complete weighs seventy-five pounds. It is steadier than the light guns of the French service, and still when it is turned over on the sledge-shaped part of the mount, the crew can haul it speedily out of harm's way or to a new field of activity as fast as the French can move their lighter but clumsier-to-carry Hotchkiss gun.

Just at present the Germans are the machine gun artists of the civilized world, and the guns play the most important part in holding their line on the west front.

The other day an American chief of ordnance of our army, asked for funds to build seventeen thousand machine guns—there being about one thousand on hand!

One of the marked features of the machine gun is the encouraging effect on the troops on its own side, and the terrifying effect on savage peoples. Not long after the Spanish War, the American Army authorities found a job on hand on the island of Sulu, subduing a band of a thousand or more men, women and children of the bandit variety, who had ensconced themselves in the crater of Mount Dajo, a high and precipitous isolated peak that had been an extinct volcano.

Lieutenant Leighton Powell, who was with "Machine Gun Parker" at Santiago and had caught the fever from the famous American believer in that sort of weapon, found, neglected and hidden in dust and cosmoline, a Colt machine gun in the warehouse at Sulu. He asked and received permission from the scoffing infantry officers to form a machine gun section and to take the gun up the mountain with the attacking force. He gathered together a group of infantrymen, made gunners out of them, drilled them faithfully and hard—only to be left behind by the main body of troops when the columns departed for the attack. That evening, however, there came a messenger for Lieutenant Powell to bring on his blamed machine gun—the army had found the mountain a tough-looking nut to crack. So joyfully they packed up the Colt and trekked for the big mountain.

That night two columns crept up the mountainside. Powell made a Moro sandwich, with a Moro carrying ammunition or machine-gun part, then an American gunner, then a Moro, then an American, and so on, to keep the natives from sneaking off in the dark. Every now and then the

© Int. Film Serv.
German soldiers transporting one of their machine guns and mount to a new field of activity

Yankees would poke the natives in the back to make sure all was serene.

The Americans rushed the cottas defending the trail at daybreak, and found themselves on the edge of a bowl at the mountain top, some four hundred yards across, packed with huts and Moro cottas or forts. Also several hundred enthusiastic Moro bandits were potting at the Americans from every part of the crater.

Presently in the midst of the fitful crackle of the rifle fire, there broke out a sound no Moro had ever heard, the vicious and sustained chatter of the Colt machine gun. From that instant, the Moro fire slackened, while the machine gun searched methodically the light bamboo cottas of the Moros, the bullets ripping through as fast as spray from a hose. I saw a picture of some of the cottas and trenches taken a few hours later. It was not a pretty picture—particularly in view of the fact that women fought with men, and there had been no chance to pick and choose in the marks for the American guns.

A Moroccan chief explaining the working of a machine gun to some new mystified army recruits

Even after such an experience as this the American Army had little faith in the machine gun. Even the Russians saw the beautiful qualities of the Gatling and bought more Gatling guns than all other nations put together, to use on the natives of Asia who objected to the Russian colonizing and exploring. When a Turcoman charge started for the Russian lines, the Gatlings calmly and methodically spread Turcoman riders and horses all over the vicinity.

The field gun and the giant howitzer may masquerade as mere engineering appliances for smashing up trenches, the infantry rifle can establish a weak sort of an alibi as being partly a weapon of self-defense in that it can parry an opposing bayonet, but the machine gun is unblushingly a frightful machine for killing men. It has not the slightest utility from any other standpoint.

Although America is notoriously a non-military country, and although the market for man-slaying weapons has always been best abroad, and although the great arsenals for military weapons were across the water, yet it has been America which has evolved this most awful weapon and placed it at the disposal of modern belligerents.

The greatest man-killing machine on earth, the chattering destroyer of whole battalions, the most formidable defender of the German lines, is not only of American design originally, but is of American design in its variations as used in the present war.

Yet it is undoubtedly true that the equipment of the United States Army contains fewer of these guns than that of any other nation among the great powers.

A New Sugar Flour from Northern France

WHILE the brainiest men of Europe are working over the war situation, new geniuses are arising in the ranks of the manufacturers, farmers and ordinary workmen to solve the food supply problems. In Northern France a new flour is being made from sugar beets. It is used for bread and for cattle food, as well as for certain brewing processes.

The fresh beet pulp is poured into a vat into which currents of warm air are introduced for drying. Then it is passed through a series of gratings which rotate one above another. After this the pulp is delivered into compartments in which the temperature of the air is gradually increased to about 250 degrees Fahrenheit. It is then sufficiently free from moisture to be pulverized and used as flour.

A New Air Propeller of Steel and Enamel

The framework is made of one piece of thin steel over which the glossy coating is baked

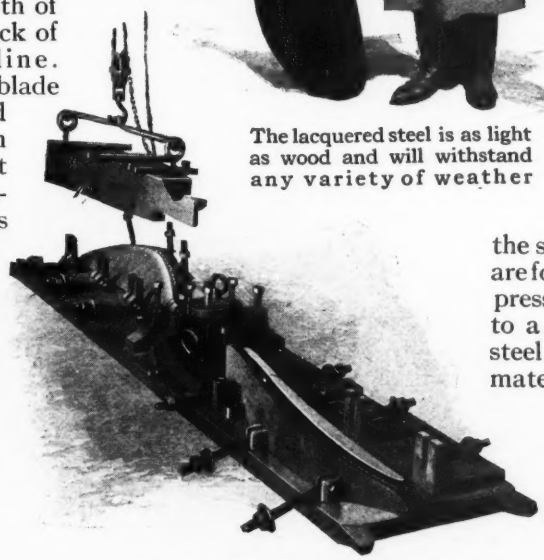
THE screw propeller of an aeroplane or airship is made like a pair of blades on an ordinary electric fan. They are, however, about a dozen times larger, and capable of throwing back a column of air several thousand times more powerful. When such a propeller is revolved at high speed, it will push with tremendous force against the air; and with equal force will the aeroplane be pushed ahead. Its operation is just like a propeller pushing a ship, only that the aeroplane propeller works against a very much lighter substance.

The first aeroplane propellers were copies of windmills. Their blades were of canvas stretched on a wooden framework. They were, however, very inefficient. The next step in advance was made when aluminum blades were riveted to steel arms which projected from the driving-shaft from the motor. But the great defect in both of them was their lack of clean-cut outline. Unless a propeller blade is made rigid and in one unbroken piece, the slightest projection or unevenness serves only to churn the air. At the high speed at which the propeller revolves, the violent churning will hinder rather than help the aeroplane in its progress.

The solid one-piece wooden propeller, invented by Hiram Maxim over twenty-three years ago, practically eliminated this defect. Its outline is unbroken and its surface is polished as smooth as glass. Nothing in the world is given so high a finish, and its clean-cut blades churn the air very little. It has one great drawback, nevertheless, in that it is affected by the weather. Changes in degrees of moisture, heat and cold warp the propeller in time. As a matter of fact, the wooden propeller of one of our military aeroplanes which ran the risks of the Mexican climate was warped suddenly while the aeroplane was high in the air, and came to grief.

The lacquered steel is as light as wood and will withstand any variety of weather

The weather-proof propeller, the next step, has only recently been developed. It consists of a thin one-piece steel framework upon which a glossy coating of lacquer is baked. The steel is pressed into just the right form by a huge steel die. The surface of the steel is treated with chemicals. This makes the steel spotlessly clean so that it can "take" the lacquer. A heavy coating of the unbaked lacquer is then spread evenly over the entire surface of the steel. The two substances are forced together under great pressure and are then brought to a high temperature. The steel and the lacquer amalgamate and one rigid piece is formed. The light lacquer strengthens the inner framework, and the propeller itself is considerably lighter on account of it than if it were of solid steel. When the propeller is cooled and polished, it forms a surface as smooth as a lacquered Japanese box. This spells efficiency. The weather-proof quality of the lacquer also enables the propeller to withstand all climates indefinitely.



The die wherein the inner framework of the propeller is pressed into shape from thin sheet steel

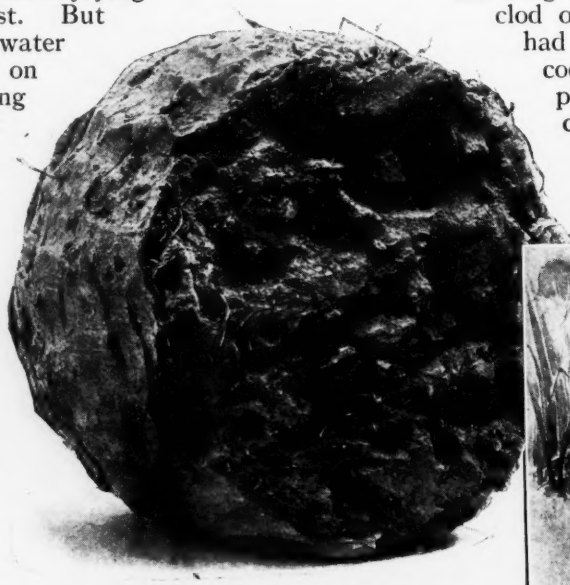
The "Missing Link" Among the Fishes

It has lungs like a land animal and leg-like fins

WHAT kind of a fish is this that the American Museum of Natural History has received from Africa? To be sure it's dead and older than Adam and Eve. But look at it. It had perfect gills and lived in the water when it could, swimming about and enjoying life to the utmost. But when a home in the water was not available on account of the drying up of the rivers at certain times, it bored down into the mud, wrapped itself in a kind of cocoon and lived there, breathing air through a perfectly good pair of lungs until the floods came and washed it out.

They call it the "lung fish." Its skin structure, its skeleton and brain so closely resemble certain land types that it is conceded to be a definite connecting link between the true fishes and the four-footed land animals. It has two sets of fins, which are so placed that they are slightly suggestive of legs, especially the hind ones.

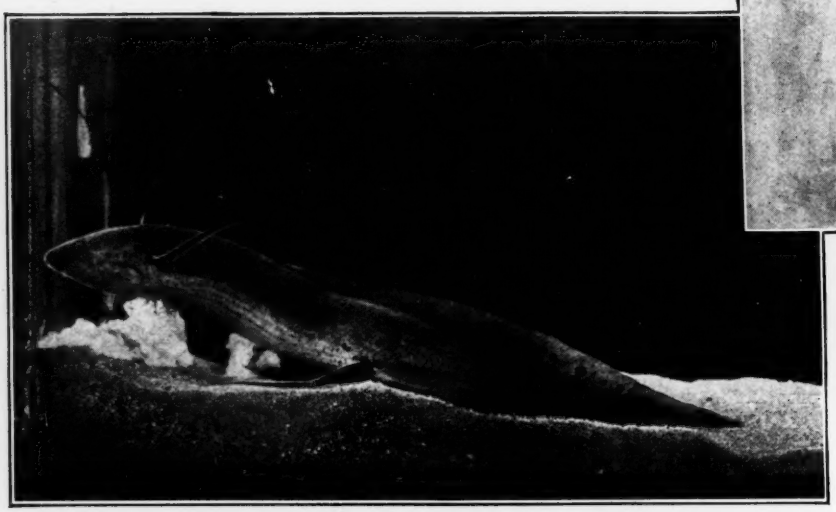
The American Museum's specimen of the lung fish was found in a clod of earth in which it had encased itself in its cocoon, a capsule of papery texture formed of hardened layers of slime secreted by its body for the purpose. At one point



The summer home of the lung fish, into which it burrowed while the earth was still moist in the river bed. There it had need for lungs until the floods came

Photos American Museum Natural History

Above: Burrowing deep into the earth as the hot, dry season approached. A breathing hole was left through which a current of air was obtained



The active lung fish as it looked in water. Note the leg-like fins and the breadth of the disappearing tail. Something similar is seen in the tadpole

of the cocoon it had formed a tube of this hardened slime. This led to the outer atmosphere and furnished air to the lungs while the fish slept there. The clod was cut from the river bed and was carried thousands of miles, but nothing disturbed the inmate until it was placed in tepid water which melted the cocoon. Then the fish awoke, to find itself in the aquarium in the hall of fossil fishes in the Museum; but whether or not it realized any difference in its environment could not be ascertained. Perhaps it merely supposed it had reached the next stage in its evolution and was surprised that the change was so slight.

The miniature hospital camp is true in every detail to the ideal it represents. Even escort wagons and mules are shown

A Toy Field Hospital for an Object Lesson

A MINIATURE camp with tents about one foot high was erected during the past summer for demonstration purposes in the center of a real camp of about 18,000 troops covering nearly 1,000 acres of ground at San Antonio, Texas. It was made and set up by a field hospital company of the National Guard of Florida, just to show how a model field hospital should look.

The tents were made of regulation khaki-colored canvas with the prescribed number of guy-ropes and tent pins. They included the pyramidal tents such as are used by the staff of a field hospital company and the large wall tents of the so-called "hospital" type, which house the wards for the patients, and the operating rooms.

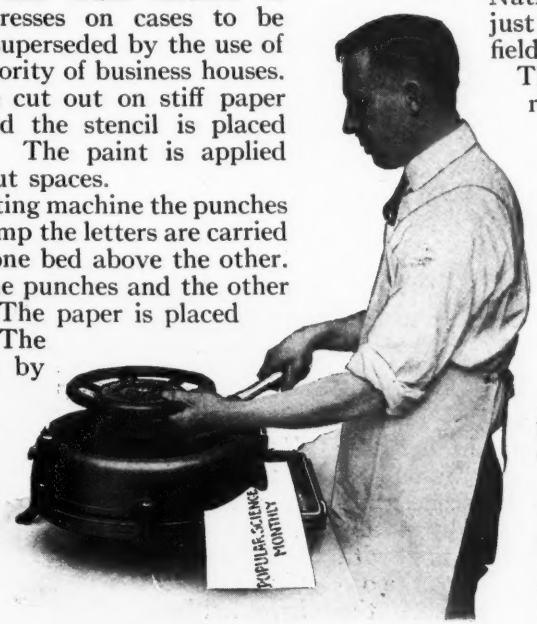
Miniature army escort wagons that were made according to scale were parked at one end of the model camp and near them was a picket line where a number of toy horses and mules stood with their noses buried in tiny bundles of hay.

Within the ward tents were cots and other furnishings and in front of the camp stood a flag pole from which a national emblem and medical corps flag fluttered in the breeze. Even the smallest details of the regulation hospital camp were faithfully reproduced.

A Stencil-Cutter Is the Typewriter of the Shipping-Room

THE old pot and brush method of painting addresses on cases to be shipped has been superseded by the use of stencils in the majority of business houses. The addresses are cut out on stiff paper by the cutter, and the stencil is placed against the case. The paint is applied through the cut-out spaces.

In the letter-cutting machine the punches and dies which stamp the letters are carried on circular beds, one bed above the other. One bed carries the punches and the other carries the dies. The paper is placed between the two. The beds are rotated by a wheel until the proper letter-punch is in position. This is indicated when the pointer on the wheel stops in front of the corresponding letter on a stationary scale. The punching-lever is then pressed, and the punch and die come together and force the outline of the letter through the paper.



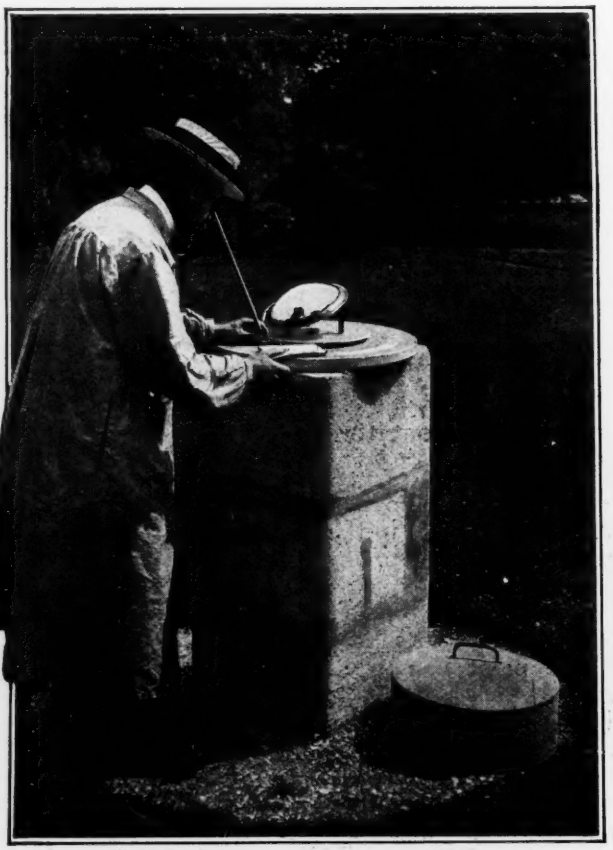
The stencil is prepared by forcing letter-shaped punches and dies through stiff paper

Stencils made in this manner cost but a tenth of a cent each. Each stencil can be used many times. They are so clear-cut and legible that some steamship companies will not accept packages marked in any other way.

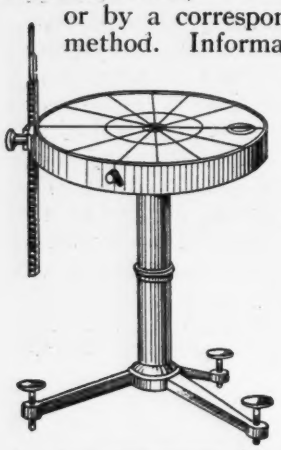
That Cloud—How Fast Is It Drifting?

How statistics are gathered upon which meteorologists base their theories concerning the atmospheric circulation

HOW high are the clouds? How fast do they move? In what directions? Answers to these questions are of great interest to the student of the atmosphere, because the clouds furnish the same kind of information about the movements of the air at high levels that we obtain near the earth by means of weather-vanes and anemometers. Accurate measurements of the altitude of clouds may be obtained by observations made simultaneously from two points with theodolites, or by a corresponding photographic method. Information on this subject has also been obtained by noting the location, with respect to the observer, of the shadow of a cloud on the ground, in conjunction with the angular altitude of the sun. These data give us the base and the angles of a triangle, of which the altitude may be computed trigonometrically. The altitudes of clouds range all the way from *nil*, when the cloud rests on the ground and constitutes a fog, up to about seven miles, in the case of the feathery clouds known as "cirrus."



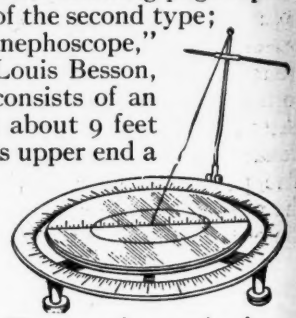
The nephometer, a convex mirror, the surface of which is divided by lines into ten sections, is used to determine degrees of cloudiness or relative areas



A mirror instrument for measuring cloud motions

The instruments used in observing the motions of clouds are called *nephoscopes*, and these are of two principal types, distinguished as *reflecting nephoscopes* and *direct-vision nephoscopes*. In the former the movements of the cloud are observed in a black mirror, and this is the type commonly employed in the United States. In the latter the cloud's motion is observed directly, with relation to some fixed object.

The picture on the following page represents an example of the second type; viz., the "comb nephoscope," invented by Dr. Louis Besson, of Paris. This consists of an upright brass rod about 9 feet long, bearing at its upper end a cross piece 3½ feet long, to which a number of equidistant vertical spikes are attached. The rod is mounted in a



The type of measuring instrument known as the Marvin mirror nephoscope

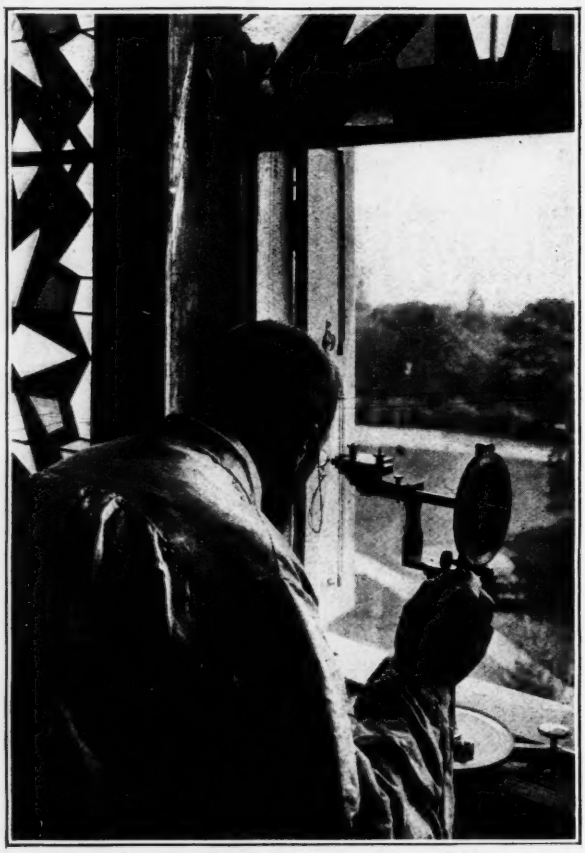
Timing the Clouds to Determine the Weather

The "Comb Nephoscope." It consists of an upright brass rod about nine feet long, bearing at its upper end a cross-piece to which a number of equidistant vertical spikes are attached. The observer turns the cross-piece until the cloud appears to travel along the line of spikes, and notes the time it takes to pass from spike to spike. This forms a basis from which he reckons

vertical position by means of rings and clamps screwed into a tall post in such a manner that it can rotate freely. Its height can also be adjusted so that a fixed point on the rod is at the level of the observer's eye. In using the apparatus, the observer stations himself in such a position that the cloud selected for observation is seen in the same straight line as the central spike. He then turns the cross-piece until the cloud appears to travel along the line of spikes, while he remains motionless. The cross-piece will then be parallel to the line of motion of the cloud, and the direction in which it points can be read off on a graduated circle which is fixed to the rod. The rod may be turned by an observer standing at some distance away from it by means of two cords tied to a second shorter cross-piece attached to its lower extremity.

The observer notes the time the cloud takes to pass from spike to spike. The distance between two spikes is known, and also the altitude of the cross-piece above the observer's eye. A rudimentary knowledge of geometry tells us that the ratio of the latter distance to the former is the same as the ratio of the cloud's altitude to the actual distance it travels in apparently passing from one spike to the next. The altitude of the cloud may be assumed to be the average altitude for a cloud of its type.

The *nephometer*, shown in another picture, is used to determine "degree of cloudiness," or relative area of the sky covered by clouds.



The observer is sighting the image of a cloud reflected into the mirror from an artificial pool of water below the window, to determine its height

What Is a Man? Break a Thousand Eggs and You'll Have His Contents

WHAT is a man? How much is he worth from a scientific viewpoint?

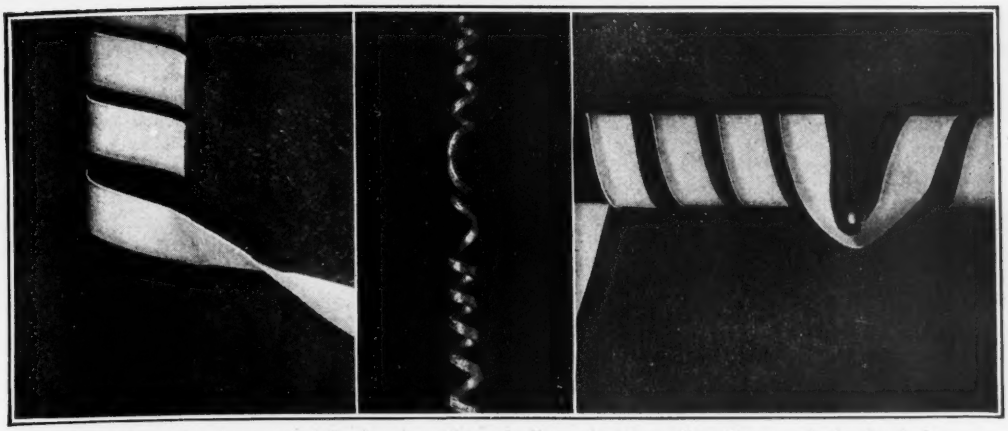
According to one way of looking at it a man is worth about $2.50 a day from his shoulders down and anywhere from $50,000 to $1,000,000 a year from his shoulders up. This may be said to be the estimate of the average successful business man.

The scientist, however, looks at the question from another angle. According to him a man is worth $2.45 for illuminating purposes, since a man weighing 150 pounds contains about 3,500 cubic feet of oxygen, hydrogen and nitrogen in his constitution, which at seventy cents per 1,000 cubic feet equals the price above. Also a man contains enough carbon to make 9,360 lead pencils; enough phosphorus to make 800,000 matches or enough to kill 500 persons, and enough water to fill a thirty-eight quart reservoir.

Furthermore, it makes no difference how sour a man may look he contains about sixty lumps of sugar, a great deal of starch, chloride of potash, magnesium, sulphur and hydrochloric acid in his system. There are fifty grains of iron in the blood of an ordinary man, enough to make one spike large enough to hold his weight.

What is a man? This is the somewhat cynical answer of one scientific man:

"Break the shells of 1,000 eggs into a huge pan or basin and you have ingredients from which to form him from his toe nails to the most delicate tissues of his brain."



In the center is a tendril showing the windings in two directions and the hook in the center. At sides the principle is illustrated with a strip of paper over a pencil

Why the Tendrils of a Plant Grow in Two Directions

WHEN a climbing plant has attained such a height that its weight will prevent it from growing upward it begins to throw out tendrils which grasp other bodies for the purpose of support.

Somehow the plant knows where a neighboring object is to be found and throws out tendrils in that direction. At first the tendril is straight, but as the object to be grasped is approached a little hook is formed to act as a catch. The moment this has been accomplished the tendril begins to coil up, going first from right to left, then forming a loop and going from left to right.

Such a tendril is so elastic that there is little danger of its snapping off when the vine is subjected to the sudden strain imposed by the alighting of a bird or the blowing of a sudden gust of wind.

But why should the tendril grow in two directions? This is a question which has puzzled many. It is answered in the illustration above.

In the center of the illustration is a photograph of a tendril, showing the two coils in opposite directions and the loop between them. Now let us take a narrow paper ribbon and coil this around a pencil as at the left of the illustration, meanwhile holding the unwrapped portion firmly between the fingers. For every turn we make around the pencil, the other portion of the ribbon will make a corresponding twist. If we were to continue the process the twist would finally become so tight that the paper would tear. If we make a loop in the ribbon, as at right of illustration, and wrap the ribbon in the opposite direction on the pencil it will be seen that the twist is uncoiled. This is the principle involved in the growth of the tendril.—LEHMANN WENDELL.

A Switchboard Operator Finds Time to Embroider

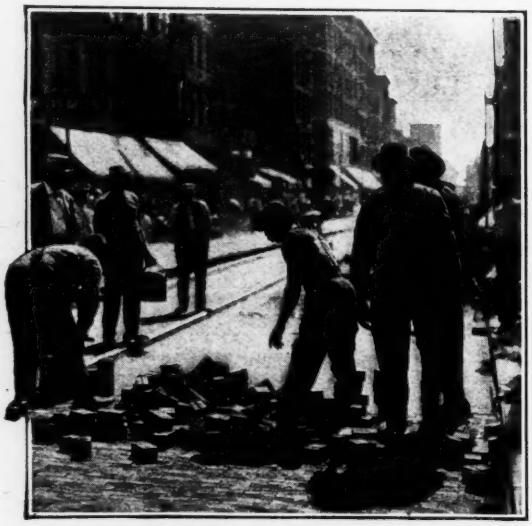
THE accompanying illustration shows how a busy telephone girl proves the truth of the old axiom, "Where there's a will there's a way." She has had a clamp attached to the edge of her switchboard, to which is fastened a hooked ring to hold her embroidery frame. She has only to make her connections when a call is received, and then her hands are free. She can talk through the mouthpiece while her hands are busy with the needle. In this way she not only fills her "hope chest" without wasting her employer's time, but she relieves the tedium of the hours and the nerve strain.

She is attending strictly to business and embroidering at the same time

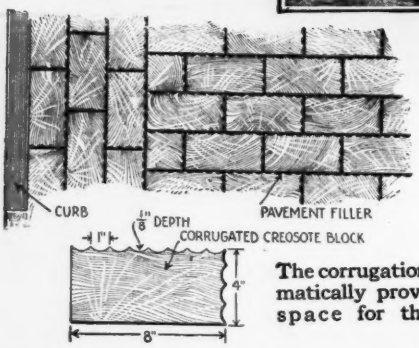
The Corrugated Wood Block for Street Paving

THE corrugated wood block marks an important advance in the manufacture of paving materials. One side and one end of each block are corrugated or grooved in the direction parallel to the grain by a special machine. These grooves immediately adjoin each other. The dividing lines are of almost knife-like sharpness.

The particular advantage of corrugated block lies in the fact that the blocks may be laid snugly together, course on course and block on block, without fear of displaced alinement due to expansion from temperature or moisture. In laying the ordinary block the workmen must attempt to provide a space between the courses and between the blocks in the courses.



The workmen drive the courses snugly and place each corrugated block without having to make calculations for expansion



The corrugations automatically provide the space for the filler

With this newly invented block the corrugations automatically provide the necessary space for the pavement filler to flow to the bottom of the block, effectually sealing the pavement against moisture. Under certain conditions wood block has a tendency to expand. When this condition exists with corrugated blocks, the knife-like edges crush or bury themselves in the adjoining blocks, relieving the pressure at once. Each block has its own expansion joint.

Clearing a Crippled Car from Railroad Tracks

WHEN a car breaks down on a busy road, it is of first importance to clear it out of the way so that traffic may go on undisturbed. The car itself can be repaired when it reaches the barn, so that the first problem is to get it there as quickly as possible. For this purpose, the master mechanic of a Western traction company has devised a piece of apparatus which can temporarily take the place of a broken axle on a car. The apparatus is merely an auxiliary truck with small railroad wheels rigidly held apart so that they properly fit into the rails.

When a car has broken down, an emergency car equipped with a set of these trucks is immediately sent out. The crippled car is lifted up by heavy screw-jacks at the end where it has broken down. The auxiliary truck is then run underneath the broken axle, the car wheels are fitted into the frame, and the whole apparatus is strongly fastened to the car by means of heavy chains. The car then runs back to the barn by its own power.

When the car breaks down, an auxiliary truck with small railroad wheels is run under the broken axle to support it

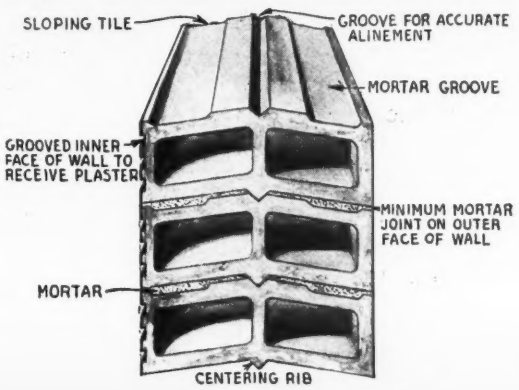
A Hollow Tile Building Block Which Is Waterproof

IF we take the word of the hollow tile enthusiasts, brick houses are disease breeders, since brick does not keep out moisture or the cold and does not retain heat. Another argument against its use is that it permits water to go through to the inner surface of the wall, making it necessary to use laths or other means to separate it from the plaster. Laths are not used with hollow tile.

The widespread popularity of the hollow-tile building block in preference to brick in the construction of our modern buildings is said to augur well for its exclusive use in the future. Of course, there are many different kinds of building blocks of the hollow tile type, all claiming to be waterproof and weather resisting. The one illustrated is the invention of Halver R. Straight, of Adel, Iowa. Between a layer of cement or mortar and each rib there is a dead-air space which prevents the flow of water or the transmission of moisture.

The inventor claims that if water enters the vertical mortar joints between his tiles it will not flow toward the inner surfaces of the wall, but will be conducted back to the outer surface. Each tile contains two recesses for cement or mortar, a rib, a groove, and a top and bottom surface which incline downward from the groove. The rib of one tile fits into the groove of another, so that the blocks can be alined with exactness. Furthermore, the tile does not need to be hammered or pounded upon to force it down in its proper position.

Above: A house built of hollow tile. Below: A type of hollow tile through which moisture cannot enter



The kerosene oven. A copper tube brings the oil from the nearby tank. A hand pump supplies pressure

Army Cooks Prefer Kerosene to Wood for Fuel

ARMY camps along the Mexican border are experimenting with kerosene as a fuel substitute for wood in the field bakery ovens. In localities where wood is scarce, oil is much cheaper and more reliable than wood, and there is no danger from sparks.

A simple burner is used. It consists of a piece of pipe extending the length of the fire box and containing a number of holes through which the oil is forced under pressure. A flexible copper tube brings the oil to the burner from a nearby supply tank holding about fifteen gallons. Pressure is applied to the oil by means of a hand pump, the amount being determined by a gage.

By burning oil an oven may be brought to a baking temperature in less time than when wood is used. The baking can be started at any time on short notice and the bakers do not have to contend with wet or green wood.

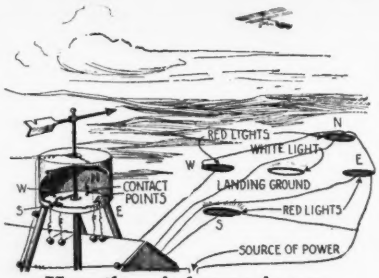
How the German Aviators Land Safely at Night with their Aeroplanes

BECAUSE of the great danger in making a landing at night the aeroplane is preeminently for use only by day. On the warring fronts in Europe there are sometimes flocks of aeroplanes in the air at the same time. But when the sun goes down the aeroplane goes down with it, usually, to stay in safer regions for the night.

But for all the danger connected with night flying there are many aviators intrepid enough to venture forth in the dark. In fact, the problem of making a safe landing at night has been solved by the Germans in an ingenious manner.

An aviator making a landing at night, with the white and red lights on the field below to guide him

In the center of the landing field a large, white light is placed, sunk in a pit in the ground and covered over with a sheet of thick glass to bear the weight of the aeroplane should it pass over it. Sunk in the ground at a distance of about two hundred and fifty feet from this white light are four red lights corresponding to the cardinal points of the compass. Mounted on a mast or tower at some convenient point is a wind vane. Subterranean cables lead from it to each of the red lights.



How the wind vane is connected with the red lights by means of underground wires

At night the central light glows constantly, while the red light in the direction of the wind that happens to be blowing also shows, telling the aeroplane pilot of the wind conditions where he is about to land and enabling him to make his own calculations of the field, using the two lights as a working base from which to draw his diagram.

The lights are altered every now and then to prevent enemy airmen from using them as guides.

When the Cows Go on Strike, Try Artificial Milk

ALMOST any natural product can be imitated. In the matter of food imitations, the original article is first carefully analyzed and its constituent elements noted. These elements are usually obtained from vegetables and minerals for the substitution. In fact, the science of substitution is becoming a great factor in modern industry.

In England an artificial milk is being manufactured which is claimed to be both wholesome and inexpensive, so that now the market is not wholly dependent upon the product of the cows. The artificial milk is made from peanuts, soya beans, sugar, water and mineral salts. About four hundred grains of potassium phosphate or an equivalent of sodium phosphate is dissolved in two hundred pints of water at 176 degrees Fahrenheit. Enough sugar is added to give four and five tenths per cent to the finished product. Forty pounds of meal prepared from the nuts and beans is stirred in. The solution is boiled in a steam-jacketed pan; then it is subjected to the operation of a vacuum pan, and lastly it is treated with a culture of lactic bacteria until the required acidity is obtained. After it is pasteurized and cooled a small percentage of citric acid is added.

The milk thus produced may be condensed and sold in cans, or dried and powdered, or sold as a liquid in bottles. The addition of nut fats will give a certain proportion of cream. By using sufficient lactic bacteria the product may be cultured to give a table cream or a soured mass for making cheese. A milk made from soya beans has long been in use among the Chinese.

A Jeweler's Daughter Wears a Potato Necklace

GATHER around, ye wealthy farmers, and gaze upon the first potato-necklace! You will perceive that the poor city folk are at last recognizing the true value of your commodities and assigning them a more conspicuous place in the scheme of things.

This costly necklace was made by a Cincinnati jeweler who experienced much difficulty in securing enough of the gems to complete the rare bit of jewelry.

You will observe that the largest of the potatoes is studded with diamonds. The egg suspended from it is also supplied with them.

No less than 10,000 persons were satisfied with only a look at this potato-necklace while it was on exhibition in the show-window. No one asked its price.

The potato raised to the highest degree of importance and studded with "diamonds"

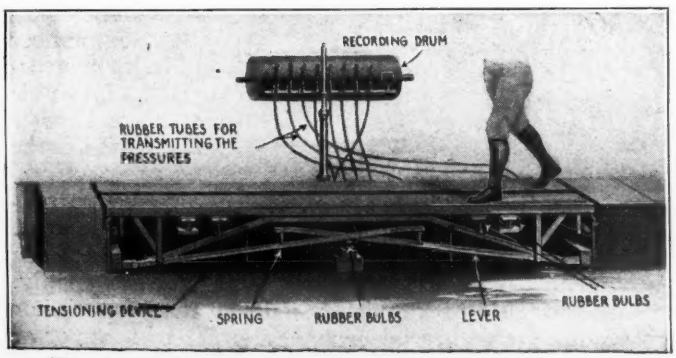
Testing the Operation of Wooden Feet and Legs

FRENCH surgeons, in collaboration with manufacturers of artificial limbs, have made remarkable progress in their endeavors to provide mutilated soldiers with satisfactory substitutes for their lost legs. Some of the artificial legs devised, however, tire the user too quickly or cause objectionable chafing or perhaps wounds.

A Mr. Amar has recently discussed before the French Academy an ingenious invention called the dynamo-graphic sidewalk, which promises to be of great service in the testing of artificial legs and in determining whether new constructions of such legs are free from the ordinary defects. Its purpose is to record accurately all movements of the foot during walking, their character as well as their intensity, so that it will be possible to ascertain accurately the working of a leg and to choose a type of artificial leg best suited to the individual for whom it is intended.

The apparatus consists chiefly of two boards (each about eight and one-half feet long and about ten inches wide) arranged side by side, but independently of each other. These boards are supported by a system of joints, springs and levers in such a manner that they will respond to the slightest pressure exerted on them, not only vertically, but longitudinally and laterally as well. These pressures will be received by the respective levers in the exact proportion of their intensity and transmitted to rubber bulbs, which in turn act by means of pneumatic tubes on recording drums.

The two boards being independent of each other, the movements of each foot will be conveyed separately to the respective levers, which resolve them into their several components and transmit the result of this analysis to the recording devices, of which there are four for each foot. It will thus be easy to read off the vertical pressure of the leg when it comes to rest on the board, the rearward push of the foot before throwing the body forward, and the inward and outward pressure it exerts. The data thus obtained are complemented by time measurements.



The device records every movement of the foot during walking, so that it is possible to determine types of artificial legs best suited to special needs of cripples

The lower portion of the image is of gray rock, but the crown is of red volcanic tufa

The Mystery of the Stone Giants in the Pacific

THE mystery of the stone giants of Easter Island—a lonely mountain in the Pacific—will, perhaps, never be solved. Some of the giants were between thirty-five and forty feet in height. They originally stood on huge platforms along the coast, in rows, looking out to sea. Thus they are described by various navigators who first noticed them about a century ago, though what they represent, whether savage gods or departed kings, nobody knows. The theory is advanced by some scientists that the present Easter Island is but the remaining apex of a much greater body of land that has sunk beneath the waters. This, of course, is merely speculation. The great statues, however, seem somewhat out of proportion to their restricted areas. It is well known that the inhabitants of the island were at one time ferocious cannibals, and mention has been made by various navigators of fierce tribal wars, the opposing factions having apparently tried to annihilate or devour each other. The result has been that the island is practically depopulated and the statues or idols have all been thrown down. Not one now stands in its original position. Several of the smaller figures have been transported to museums. The lower portion of the image in the photograph is hewn out of gray basaltic rock but the crown is a striking red volcanic tufa. The features do not suggest either the Indian or the African; so the race to which the sculptors belonged is as hard to determine as the meaning of their work.

An Indian "Corn Mill"—Their Nearest Approach to a Factory

IN spite of the fact that one is irresistibly inclined to sympathize with the American Indian and to consider him a somewhat abused and deceived creature, a thoughtful person must admit that the lack of progressiveness on the part of the Indian was responsible for his loss of place.

The accompanying photograph shows a busy mill, where the Mono Indians ground their corn into meal with stone pestles, in the same manner as their ancestors did for countless generations. Holes were dug out in the clay and baked dry and hard. Then the acorns or grains of corn were shelled and ground to powder by the women with the heavy stone pestles. A number of holes in a specially favorable spot, such as is illustrated, is the nearest the Indians came to community work. Even here, each woman ground her own private supply. There was no specializing in the work nor commercial exchange either of labor or of commodities.

The holes are from a few inches to about two feet in depth and many of them still contain the pestles

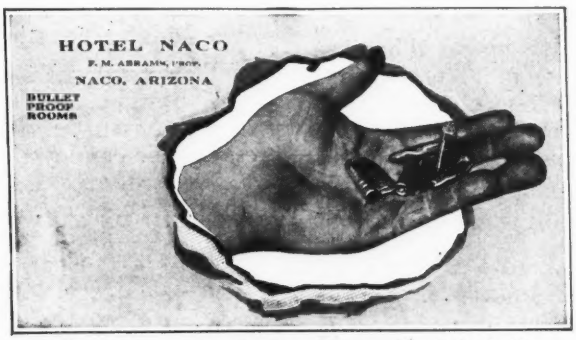
This mill is located in the foothills of the Sierras, over-looking the San Joaquin Valley.

"Bullet-Proof Rooms, Two Dollars per Day"

For one dollar extra you can sleep in peace in this hotel on the Mexican border

The rooms in the bullet-proof portion of the hotel have thick reinforced walls of adobe, the Mexican unburnt, sun-dried brick, while the other portion is of frame construction

A HOTEL in Naco, Arizona, advertises its ability to protect its guests from "stray" bullets from across the Mexican border with the same pride that the boniface of a twenty-story hostelry in a big city calls attention to his high-speed elevator service. The proprietor of this hotel advertises his "bullet-proof rooms" on the writing paper of his establishment and he is prepared to back up his guarantee. Chipped places in the adobe walls of his building give evidence of bullets which have lodged in but have been unable to penetrate the structure.



Bullets taken out of the adobe walls of the bullet-proof rooms, which they were unable to penetrate

Naco is a border town. Half of it is within the United States and the other in the State of Sonora, Mexico. One pitched battle and several lesser engagements have occurred during the past few years when revolutionist forces have attacked the Mexican portion of the town. Many bullets which failed to take effect on its citizens or their adobe houses found their way across the line and lodged in the homes of Americans. The houses on the United States side of the town are mostly of frame construction and more than one of the steel-jacketed bullets penetrated their frail walls and injured the residents.

Naco's one and only hotel is a two-story structure of barn-like architecture. One half of it, that closest to the Mexican line, is of frame construction, but the main portion is built of adobe and has thick walls of sun-baked mud that are nearly as hard as brick. A bullet may penetrate the frame portion but the adobe walls form an impassable barrier.

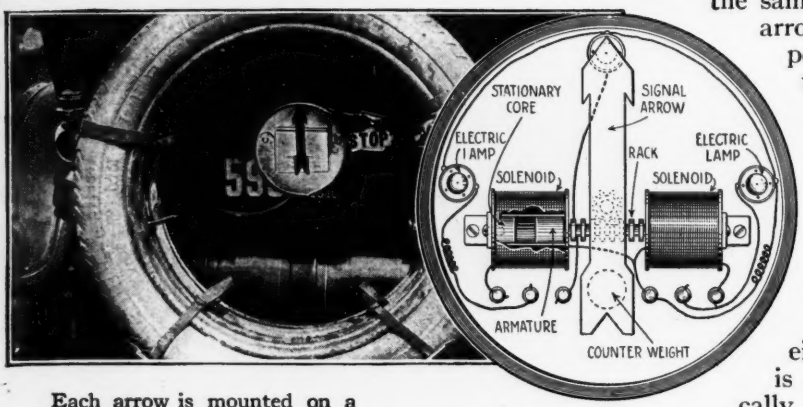
Rooms in the adobe portion have been in demand whenever trouble has been impending across the border. Not only transients patronize them but also residents of the town whose homes are not bullet-proof.

Taking Portraits against a Background of Soap Bubbles

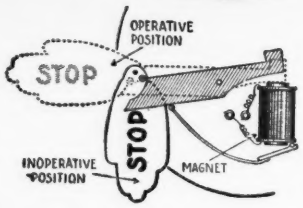
PROFESSOR Boys, of England, experimenting with bubbles, obtained some very large ones, which in the sunshine changed colors so beautifully that he conceived the idea of using them as backgrounds for photographs.

The large bubbles were blown with an ordinary bellows. The soap solution was heated and a large-mouthed funnel was dipped into it. The bellows, connected with the funnel, was then worked very gently. Bubbles with as great a circumference as two and a half feet were easily obtained.

An Electric Signaling System for the Automobile



Each arrow is mounted on a small cog-wheel which meshes in a horizontal rack gear, the ends of which act as armatures in two solenoid coils



A NEW type of automobile signal designed to make the course of the car perfectly clear to the traffic officer or following vehicle, employs fairly large arrow dials at front and rear to indicate turns, and a mechanically-operated hand at the rear to indicate a stop. The device is operated by electric current obtained from the storage battery now usually fitted on cars and is manipulated from a small control-box mounted on the steering-column directly below the driver's hand-wheel.

Each dial is glass-covered, like a circular thermometer, to keep out dust and dirt. Each is provided with a large black arrow, which stands out against a white background and is therefore discernible at a sufficient distance to avoid collisions at the rear. Similarly the arrow on the front dial suffices to signal to the traffic officer the direction in which it is desired to turn.

Both dials are electrically lighted at night by means of three small bulbs. The front dial is held in front of the radiator by means of a clamp around the filler-cap. The rear dial is close to the license-plate, the electric bulb illuminating it also serving to light up the white hand with the word "Stop" in large, black easily distinguished letters.

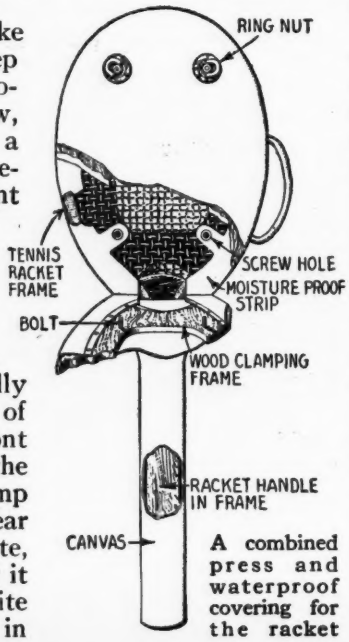
The front and rear dials are wired up on the same circuit so that the arrows in both always point in the same direction. Normally each arrow points vertically upward; but when it is desired to turn, the driver pushes a button on the control-board to turn them to right or left so as to indicate a turn in either direction. This is accomplished electrically by mounting each arrow on a small cog-wheel, which meshes in a horizontal rack-gear whose ends act as armatures in two solenoid-coils. Energizing either coil draws the rack into that coil and turns the arrow that way.

An Ingenious Cover and Press for the Tennis Racket

AFTER hard use a tennis racket warps. The gut becomes loose and saggy. To preserve the shape of the frame a racket press may be employed. But the press does not prevent the gut from being affected by atmospheric changes. Clearly, a moisture-proof cover is necessary.

Charles L. Bates, of Chicago, Ill., has invented a combined press and covering which seems to meet all requirements. The clamping devices on most rackets prevent the use of any covering. But the inventor has designed his cover so that it is clamped securely over the racket at the same time the press is tightened. The covering protects the handle as well as the face of the racket.

A pair of clamping frames lie on each side of the racket frame. After they are tightened by wing-bolts, as illustrated, the cover is fastened by means of eyelets. The clamping frames are provided with bolts large enough to fit any racket.



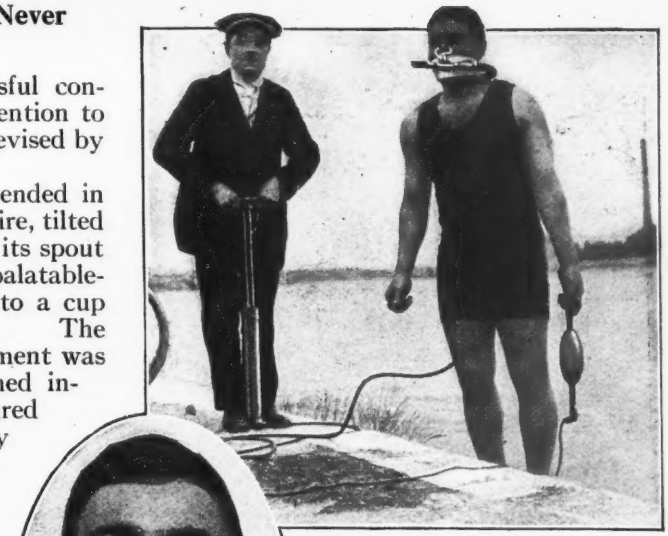
A combined press and waterproof covering for the racket

A Coffee Percolator That Never Runs Dry

A PARTICULARLY successful contrivance for attracting attention to his store window was recently devised by a Chicago merchant.

A coffee percolator was suspended in the middle of the window on a wire, tilted at a considerable angle. From its spout issued a dark brown stream of palatable-looking coffee, which flowed into a cup conveniently placed beneath. The curious part about the arrangement was that the supply of coffee seemed inexhaustible. The percolator poured into the cup hour after hour, day after day without seeming to diminish the supply. How so much coffee could be contained in the small pot was a mystery. The vessel hung on the wire entirely free from contact with other objects—seemingly an inexhaustible fount. Another strange thing was that no matter how much coffee was poured into the cup below, the liquid never overflowed, nor rose above a certain height.

The secret was this. *Up the center* of the down-pouring stream from the percolator spout ran a small copper tube, its upper end terminating well within the spout. The coffee was conducted from a concealed tank, up through the tube into the percolator and out again, this time on the outside of the conducting tube—the flow being sufficient to completely cover the pipe. The natural deep brown of the coffee harmonized with the coppery hue of the tube. The cup never ran over for the simple reason that a drain pipe at the bottom took care of the constant inflow. The cup into which the percolator poured stood upon a small tabouret whose legs were of sufficient width to conceal the two tubes—the supply pipe and the drain. An ordinary steel drill was used to bore the holes in the bottom of the cup and saucer.

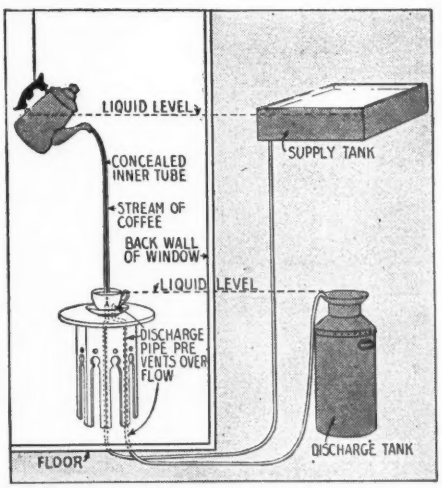


The mouth-breathing apparatus through which fresh air is supplied to a diver

Pumping Air to a Diver Through a Bicycle Pump

A SIMPLE plan which boatmen along the Seine use to supply air to divers, involves the use of a bicycle pump, the hose of which is connected with a breathing device fastened over the diver's mouth. The person on shore pumps the air at a given rate and the diver is enabled to stay under water as long as is necessary to complete his work, without returning to the surface on account of a diminishing air-supply.

The device is composed of an elastic band which fastens around the head, holding the tube in place and making a watertight covering over the mouth. The tube terminates in a mouthpiece which is held between the teeth. This mouthpiece is a miniature air reservoir, through which the incoming fresh air is passed to the air passages at the back of the throat, and the used air is expelled through an exit pipe. A pair of pinchers are clasped over the nostrils to prevent nose breathing.

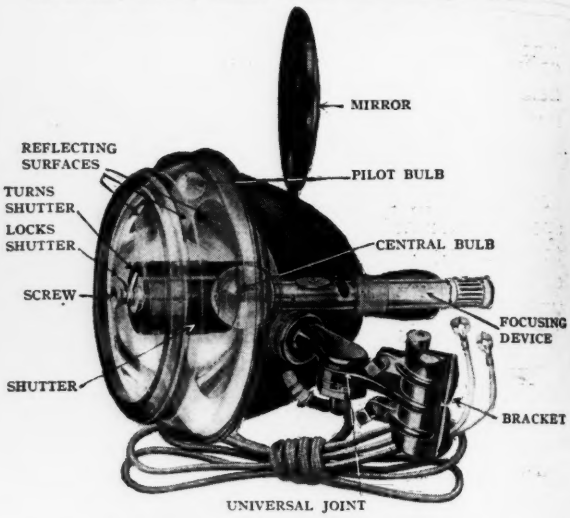


The coffee comes from a supply tank in a continuous stream, and flows out of the bottom of the cup through a drain-pipe

The Latest Conveniences for the Pleasure Car

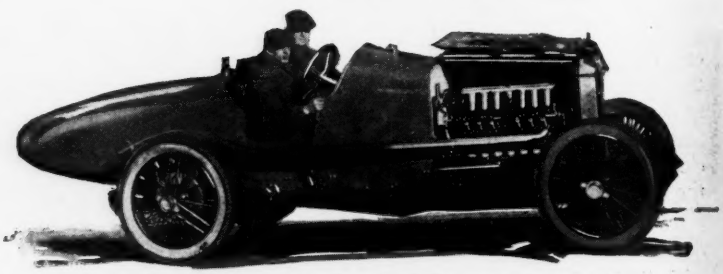
The reckless motorist will slow down when he observes the road sign above, erected by the Asheville, N. C., Motor Club at a danger spot

An automatic device for conducting vapor, after surplus water has been drawn off, from the radiator to the air intake of the carburetor. It increases power and prevents carbon



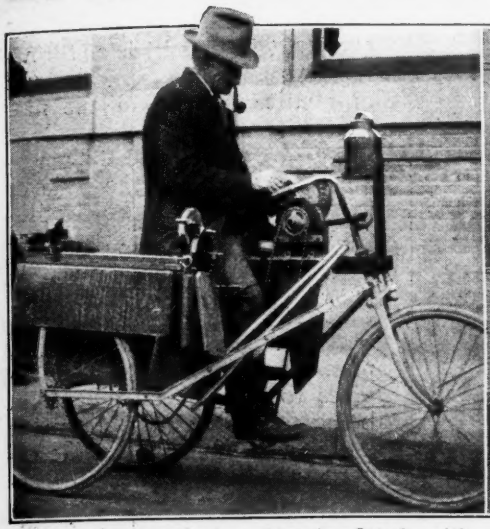
A combined spot light and mirror. The three sets of reflecting surfaces are so arranged as to prevent glare

A lock for Fords, which consists of a hinged device that fits over the front spring clip and crank



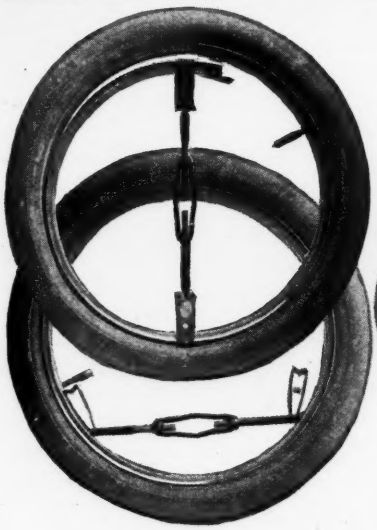
A twelve-cylinder, two hundred horsepower aeroplane motor installed in a racing car. In a recent test the car attained a speed of one hundred and fifteen miles an hour

and New Accessories for the Business Car

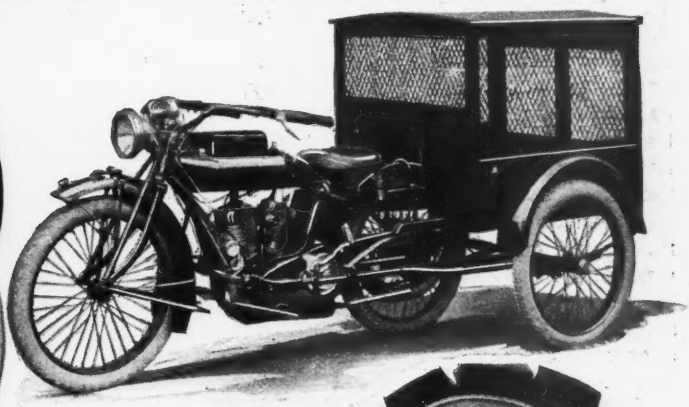


An income-producing bicycle fitted with an extra wheel for a stabilizer, and two chains, one of which turns a small grindstone

The chauffeur presses a button in a post at the edge of the sidewalk, and the doors, electrically operated, immediately open

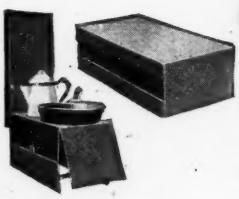


A tire tool which removes split demountable rims without delay



A new motorcycle delivery car which is especially suited for the transportation of tools and supplies

A new departure in tires—a cord pneumatic truck tire for passenger bus service and for sight-seeing automobiles



A camping stove which collapses into a box seventeen by nine by five inches

A speedy three-wheeled automobile with a two-cylinder engine, built by a Michigan photographer

Fifteen hundred dollars' worth of liquor was poured into the sprinkling wagon, water was added, and the concoction was spread over the streets of the city

Phoenix, Arizona, Finds a New Use for the "Water Wagon"

IN Phoenix, Arizona, recently, a city sprinkling wagon filled with two hundred and twelve gallons of beer, one hundred and ninety-six gallons of whiskey, eight gallons of wine and enough water to neutralize the intoxicants, was driven through the streets. The fiery concoction was sprinkled over the streets, leaving in its wake an odor which proved its genuineness. The county sheriff, his deputies and prohibitionists rode on this "water" wagon. The liquor was collected from bootleggers after the prohibition law had gone into effect.

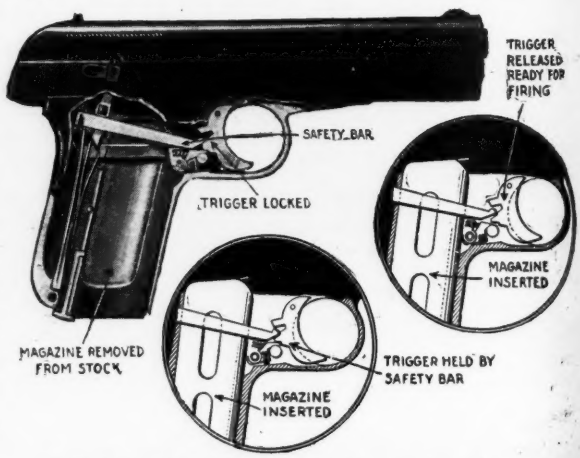
Making the Automatic Pistol Practically Foolproof

THE automatic pistol is peculiarly tricky. It has a magazine that is removable by the touch of a retainer catch, which removal is believed by nine persons out of ten, to unload and make the gun entirely safe. He loads it by putting in the magazine, thinks the user, why not unload it by reversing the process? I know of a half-dozen fatal accidents from this misguided opinion.

When the slide or bolt of the automatic goes forward, it carries one cartridge forward out of the removable magazine, and pushes it into the chamber, which is the portion of the barrel in which the cartridge rests when it is in firing position. The cartridge is now entirely out of communication with the magazine, and removing the magazine affects that cartridge as little as throwing away the box in which the ammunition came in the first place. The only way to unload the gun is to remove the magazine, then retract the slide or breechbolt by hand, which withdraws the cartridge in the chamber and ejects it from the gun.

But so common is the belief that removing the magazine removes all cartridges, that wise pistol-makers have installed devices to prevent the gun from being fired when the magazine is out. In the hands of the experienced man there is no occasion for such a precaution. It is purely to cut down the number of accidents resulting from this mistaken idea that the pistol with magazine out is necessarily empty. With such a device in use, the gun-ignorant person can remove the magazine and snap the gun at some innocent bystander without the usual regrettable sequence to such an act.

In the usual form, a little catch, held out of the way by the magazine when the magazine is in the gun, springs up and locks the trigger the instant the magazine is taken out. The user cannot fire the gun until the magazine is replaced and the catch deliberately thrown off. Then, of course, the most arrant amateur who ever handled a gun, ought to know that the gun is loaded and ready to fire, and that consequently it must be handled with care and not aimed at a comrade's head in a spirit of fun, lest an accident with dire results happen.

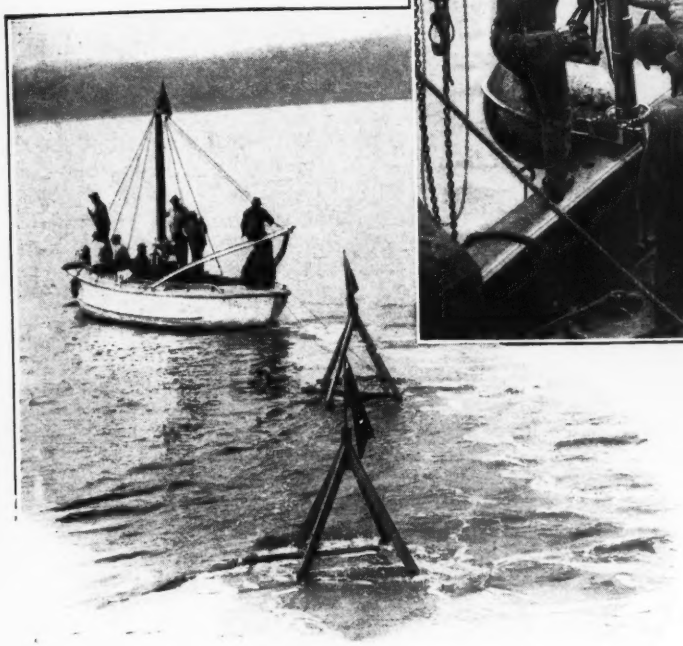


A little catch springs up and locks the trigger of the revolver the instant the magazine is taken out

The How and Why of Submarine Mines

At right: Dropping a mine. The cable is wound on a drum having an escapement like that of a watch

Below: Towing out electric cables to the mines which are controlled from the observatory on shore



NOT the least important weapon for defending our coasts and our harbors from the attacks of hostile warships is the submarine mine. Though it is perhaps the least ominous looking of naval defenses, if it is once hit by an invading warship, its tremendous explosive power will sink the ship in less time than any other weapon could.

The shock of the striking vessel automatically explodes the mine and the violently expanding gases from the powder crush in the hull of the ship in a twinkling.

Submarine mines are made of an outer casing of steel and an inner charge of high explosive. A separate chamber, containing nothing but air, gives the mine buoyancy. The mines are carried in small light-draft boats to the positions previously mapped out. The boat simply drops the mines with their anchors overboard. When the cable is all paid out, the buoyant mine will be floating about ten feet below the water's surface.

The mines lying far outside of a harbor contain their ignition system within themselves. This may be a number of percussion-pins placed all around the outside of the mine. When a ship strikes one of these, the heat of the impact ignites the powder instantly. Or, an internal ignition system may be employed. When a ship hits the mine it rolls it over. This releases an iron ball which is ordinarily held in a small cup in the center of the mine. The ball falls out of the cup and pulls upon a string, releasing a trigger and firing off the charge.

There is another type of mine in which chlorate of potash is placed in the bottom and an open vessel of acid is placed above it. The mine is anchored well under the water. Ordinary wave action does not affect it. Disturbed by a passing ship, however, the acid spills over upon the chlorate causing a violent explosion.

The mines which are near the land are generally controlled from the shore through an electric cable from the observatory.

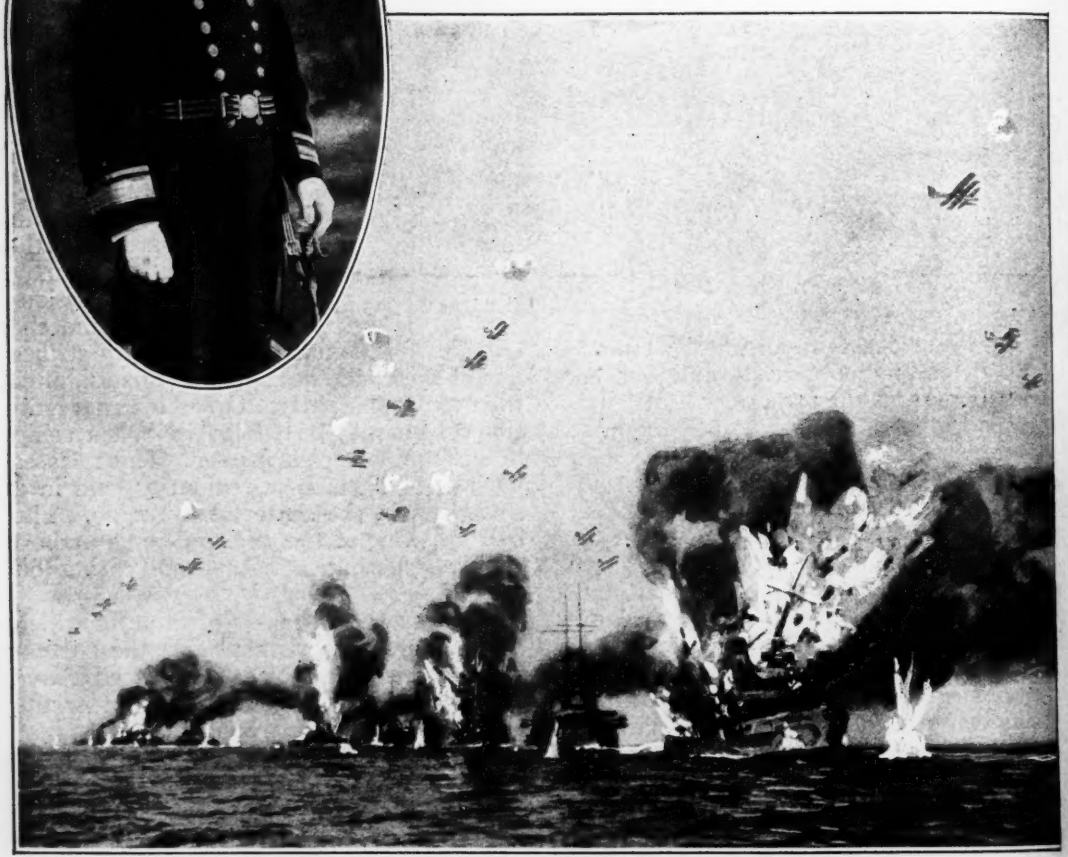
Defending America with Torpedoplanes

Battleships can be torpedoed from the air. Torpedo-carrying aeroplanes can protect us

By Rear Admiral Bradley A. Fiske, U. S. Navy

THE most startling interjection into warfare of a newly invented thing was the Ericsson "Monitor." Comparatively few of the people living now remember the tumultuous joy that ran through the northern states, when the news was flashed that the "Monitor" had defeated the "Merrimac" near Hampton Roads, on March 9, 1862; and even those of us who are old enough to remember that fact, fail to realize what a tremendous menace the iron-clad "Merrimac" was. Leaving the Norfolk Navy Yard on Saturday morning, March 8th, she rammed and sunk the United States ship "Cumberland," which carried more men and guns than she did, and, in a few hours afterward, destroyed the United States ship "Congress," also carrying more men and guns than she did. Had the "Merrimac" continued her career as successfully as she began it, she would have destroyed the navy of the northern states, and brought about the success of the Confederacy. In other words, the "Monitor" saved the United States.

The reason why the "Merrimac" and



Rear Admiral Bradley A. Fiske, U. S. N., inventor of the torpedoplane, is shown in the oval above. In the event of an attack by an enemy fleet a swarm of torpedoplanes, each carrying the

"Monitor" were so successful was because each brought into battle a weapon against which the other side did not know how to defend itself.

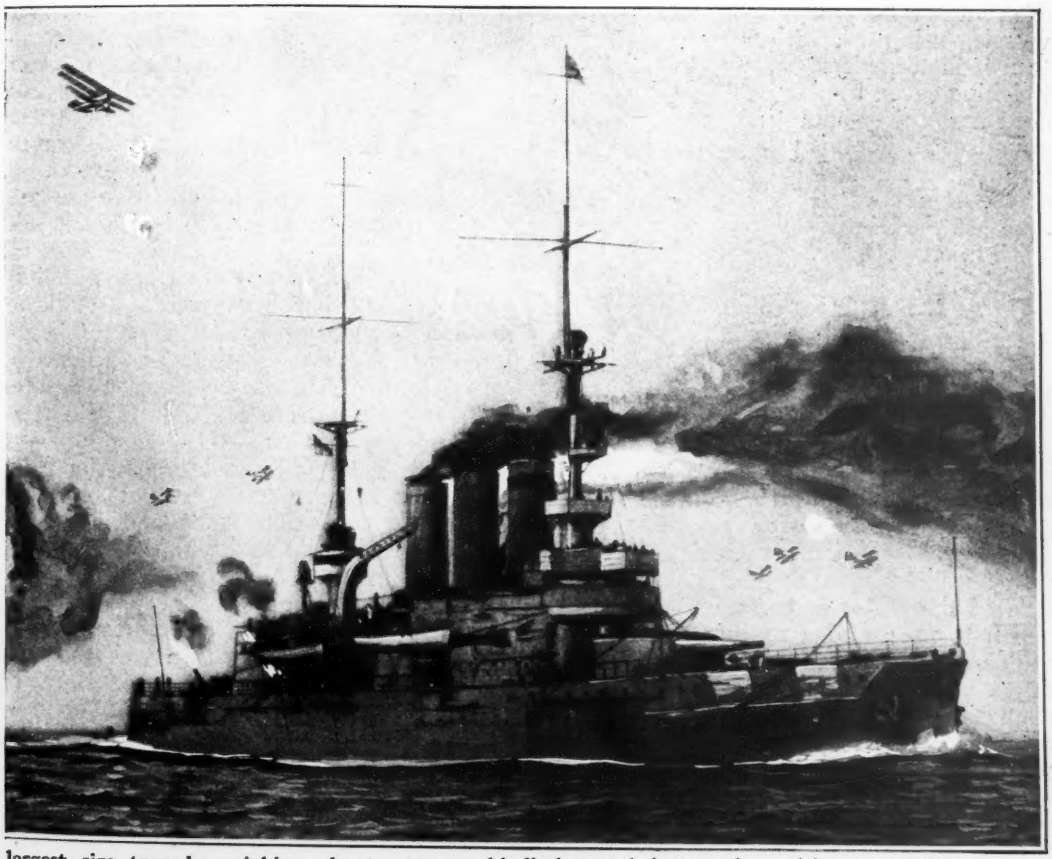
It has been suggested that the "torpedoplane," that I patented about five years ago, may prove to be an invention which may play a similar part in changing the character of naval warfare and which may help us to defend our long coast line very cheaply and effectively. At the request of the editor of the POPULAR SCIENCE MONTHLY, I will sketch here the principle of its operation and its utility.

That the torpedoplane will become an important factor in naval warfare in the near future, many people have no doubt. It is an invention which renders it possible to launch the regular Whitehead torpedo from an aeroplane as effectively as it is launched from a destroyer.

A destroyer dashes for her enemy at a speed which can rarely be as high as thirty knots an hour, and launches a torpedo from her deck into the water. That act of launching, throws back a lever on the torpedo, called the "starting lever," which causes the propelling mechanism of the torpedo to go ahead full speed. After reaching the water, therefore, the torpedo goes along in the direction in which it is pointed; and if it is pointed correctly, it hits the target ship below the water line and usually sinks or cripples her.

Maneuvering the Torpedoplane

The torpedoplane, as it is illustrated in the accompanying drawing, needs little explanation. The aviator approaches his target from a great distance and high up in the air. At a distance of, say six or seven miles away, he volplanes toward the water, runs above the surface of the water a short distance, and heads for his target. When ready he simply pulls a lever. The action of pulling the lever releases the torpedo, which is rigidly held under the aeroplane, and at the same time throws back the starting lever, with the result that the torpedo falls into the water

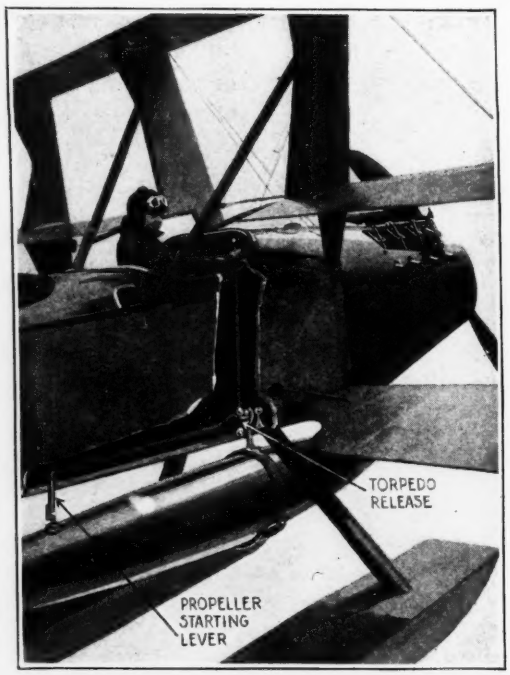


largest size torpedo weighing about a ton, could discharge their torpedoes with comparative safety. The torpedo would hit the ship below the water line and sink or cripple her

exactly as if it had been dropped from a destroyer.

I have seen it stated in print that Captain Alessandro Guidoni, of the Italian Navy, experimented with such an invention two or three years ago and that he hit the target nine times out of ten at a distance of three thousand yards. Not having an aeroplane large enough to carry a heavy, long distance torpedo, he used a light short distance torpedo suitable for the size of his craft.

I received private information from Europe about a year ago that a lieutenant in the British Navy made four flights over the land into the Sea of Marmora in an aeroplane under which a Whitehead torpedo was secured and that he sank four Turkish vessels, using fourteen inch torpedoes, weighing seven hundred and thirty-one poundseach. Forthis service,hewasawarded the much coveted medal of the DistinguishedServiceOrder.



Pulling the lever releases the torpedo, which is securely held under the aeroplane

Why the Fighting Ship Would Be Helpless

Naval officers and many aviators agree with me that it would be very difficult, indeed, for the guns of a ship to hit a torpedoplane, for the reason that accurate firing of guns from a rolling ship at an aeroplane that is neither overhead nor on the surface of the water is almost impossible.

The greatest single difficulty in firing from a rolling ship at anything near the surface of the water is to find the range at which to fire; and a rapidly approaching ill-defined aeroplane makes finding the range almost impossible. The sudden changes in the height of a torpedoplane as she would swoop down would increase the difficulty tremendously. Besides, in a contest between a torpedoplane and a ship, in which the torpedoplane seeks to strike the ship below the water, the ship, if she is struck there is disabled, if not destroyed; while the torpedoplane can be shot full of holes without much damage, unless hit in a vital place.

The aviators tell me that they see no difficulties whatever in doing their part of the work.

For an attack on battleships, the large size torpedo, weighing about a ton, would be the best. It can be fired from a distance of five sea miles or more. We now have a number of aeroplanes in this country large enough for carrying such torpedoes.

But battleships would be accompanied by a vast array of other vessels which are very important, such as destroyers, colliers, ammunition ships, scout cruisers and transports—vessels which are lightly built and which have sides so thin that a torpedo would be thoroughly effective against them. A destroyer would be especially helpless in an attack, because a destroyer's motions in rolling and pitching are so quick that her gun fire would of necessity be extremely inaccurate. Therefore, torpedoplanes could with comparative safety approach destroyers and discharge their torpedoes from a distance of a few hundred yards.

In our present state of unpreparedness, it would be a great thing if we could bring out something as revolutionary and effective as the "Monitor," something that could be got ready in the limited time that may be granted us. We cannot hope to catch up with any of the leading powers in ship or submarine building. Their output is enormous compared with ours, and their experience is greater. We are far, far behind; but I believe that our national security could be hopefully improved by keeping say fifty torpedoplanes at each of the ten important naval districts, and on aeroplane mother ships, which would go with the fleet.

When the Winds Go on a Rampage a Continent Is Too Small

TERRIFYING and disastrous in its effects as is a cyclone, it is nevertheless wonderfully impressive—unless one happens to have real estate or other interests in its path. But to be able to take any pleasure in it, you should watch it from a great enough distance to be able to get the impression of its vastness and power without being harassed by the sight of the suffering it causes, as the meteorologists and Weather Bureaus do.

The map below shows how the great tornado of 1906 looked in perspective as it tore across the country, leaving a narrow diagonal strip of land from California to Maine swept clean of houses, trees and other evidences of life and civilization. The storm began its cross-country rampage on the coast of Southern California and traveled almost due northeast, curving slightly in the center of its course. While the havoc it wrought was appalling, the area affected was comparatively small, on account of the thinness of its path.

The unusual feature of the tornado was the length of its course. Generally such storms are more or less confined to one locality.

The Torpedo-Boat Destroyer Is Defenseless against Guns

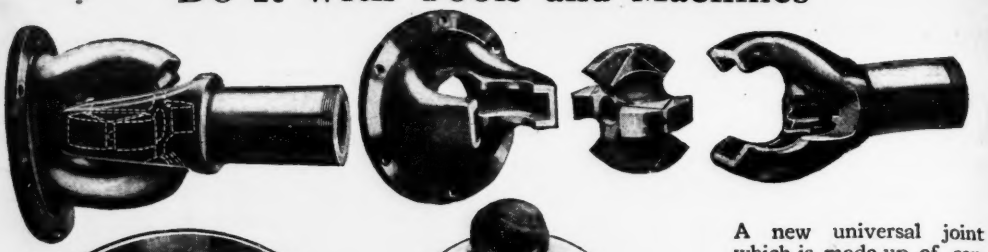
EVERYONE is familiar, of course, with the ordinary torpedo boat, a swift vessel of from four to six hundred tons in displacement, carrying no defensive armor, but armed with tubes for discharging the deadly torpedoes.

To counteract these wasps of the sea a type of vessel was designed of about double the size of torpedo boats, a little greater speed, and in addition to torpedo tubes, armed with rapid-fire six to twelve pounder guns, for the avowed purpose of destroying torpedo boats. Lately all the great nations have stopped building torpedo boats, as originally designated, and are building torpedo boat destroyers.

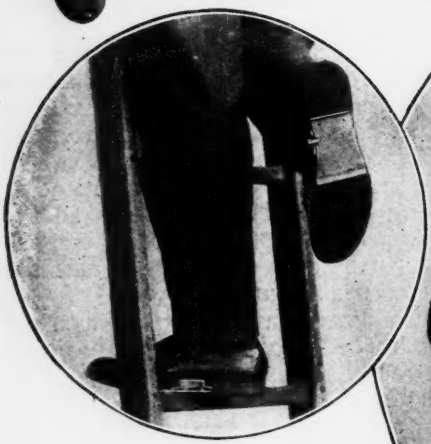
Recent engagements have developed the fact that torpedo boat destroyers are used almost wholly as torpedo boats. So, they are really battleship destroyers. To defend the capital ships from torpedo attack the dreadnoughts and battle cruisers are armed with secondary batteries of rapid-fire guns from four to six inches in diameter. One well placed shell from a gun of that size will ordinarily put a destroyer out of business, as the destroyers have no defensive armor whatever.

Starting on the coast of Southern California, the great tornado of 1906 swept a thin diagonal path across the entire country, leaving it cleared of houses, trees and all traces of civilization

Do It with Tools and Machines

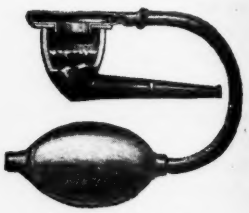


A new universal joint which is made up of center-block, slip-end yoke and transmission flange yoke

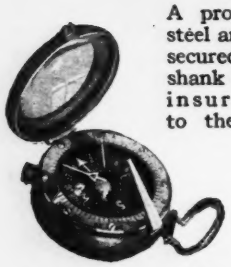


A protector of steel and rubber secured to the shank of a shoe insures safety to the climber

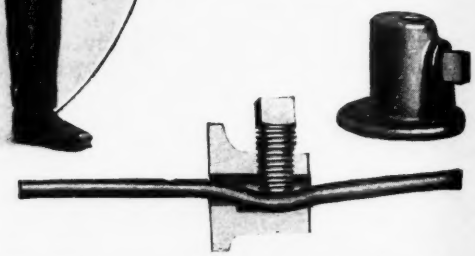
The pad saves the foot when digging with a spade and protects the shoe



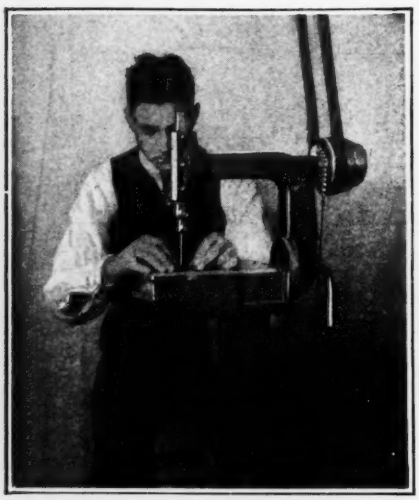
A bellows device (bulb and air-tight top) for cleaning the pipe by burning out the sediment



A compass which plots a course without a parallel rule



Bending a pipe or piece of iron at any angle with a new bolt and nut device



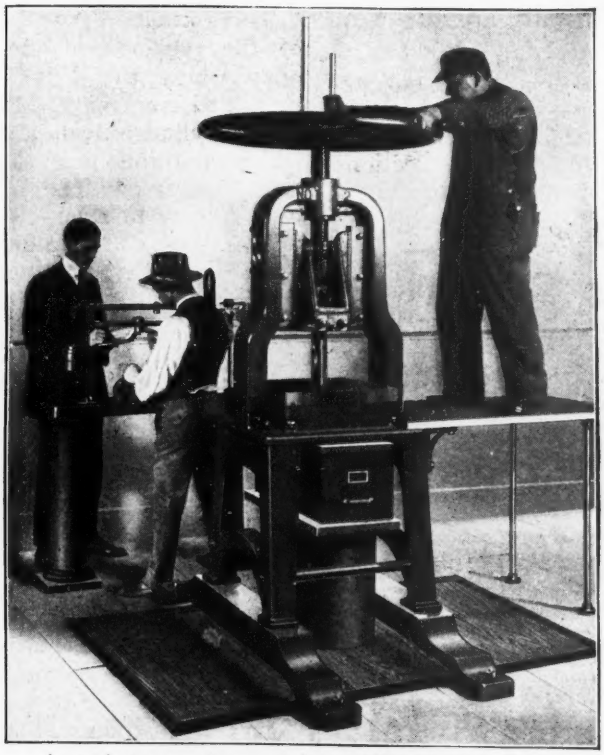
An adjustable filing machine. The table is solid but the head can be set at any specified angle and is provided with graduations for indicating the angle

A machine to drill, tap and turn in a nipple in a water main which is carrying pressure

A sanitary drinking fountain and anti-water splash which can be attached to any faucet. The water is drawn into the mouth through the glass tube

Do It with Tools and Machines

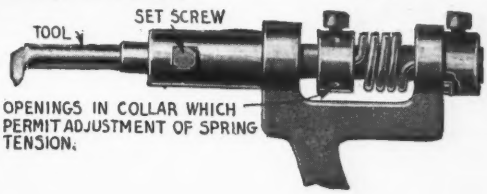
A rule tape for sidewalk use. The handle saves the operator's back and a coil spring returns the tape to the tool



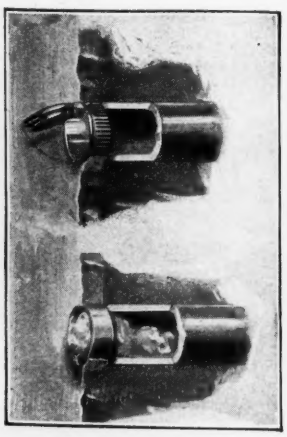
A steel storage drawer being subjected to a three thousand-pound weight in order to test its strength

A regulator for hose discharge. The farther the hose is pressed in the clamp the less water is discharged

Below: A recoil tool holder which takes up violent shocks when the tool strikes against an object

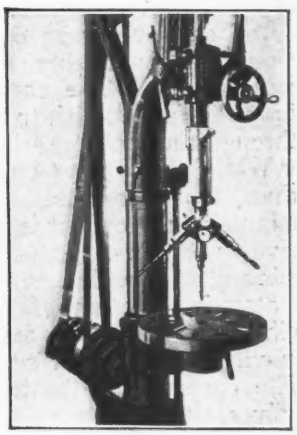


Compound lever snips which give an evenly distributed cutting strain from the throat to the point of blade



A closed bushing with top that can be easily removed with a screw driver or pliers

A machine for making and sharpening bits on drill steel. It is operated by means of compressed air. A single lever controls it

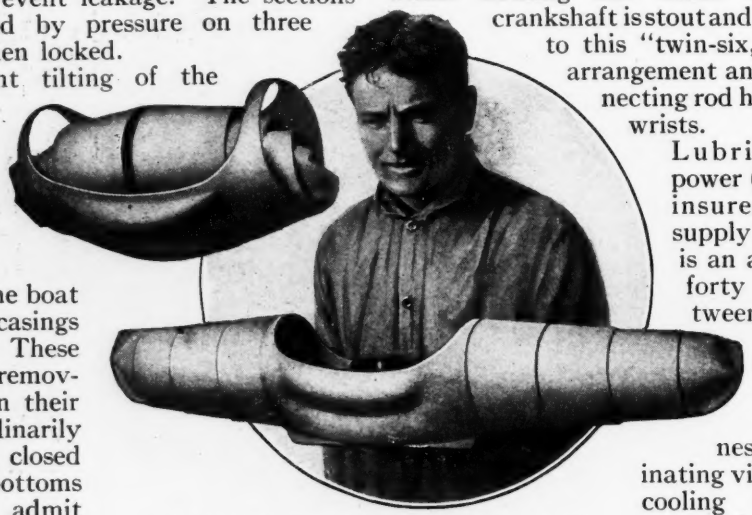


A plain drill-press turret-head for use where several operations are to be performed for interchangeable parts

You Can Rock This Boat but You Can't Turn It Over or Sink It

THE several hull sections of the collapsible boat illustrated are tapered so that they telescope. Packing rings between the joints prevent leakage. The sections are distended by pressure on three tubes and then locked.

To prevent tilting of the boat the inventor, Yves André Bouget, of Philadelphia, has attached to the hull of the boat stabilizing casings or shells. These shells have removable plugs in their tops, but ordinarily the tops are closed and the bottoms opened to admit water.



A rod and transverse bar lock the hull sections after they have been distended

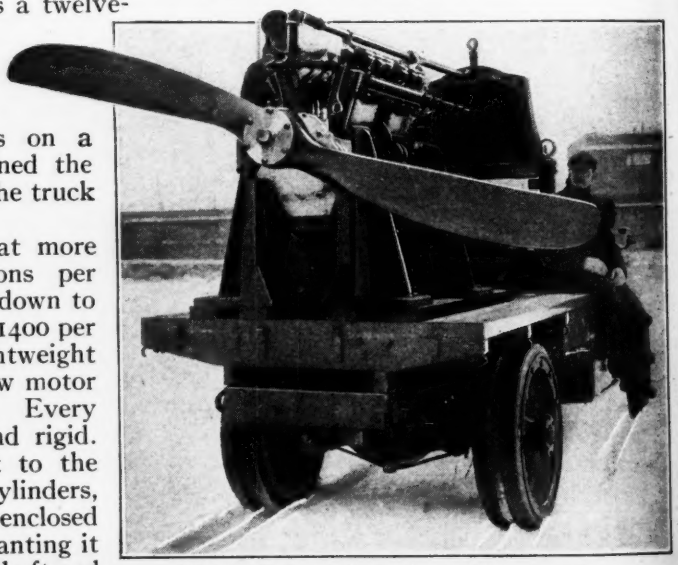
A New Twelve-Cylinder Aeroplane Engine Makes Its Début

THE aeroplane engine is the lightest motor made, for the power it gives. Although its use in driving the propeller of an aeroplane is well established by this time, it is now attracting the attention of automobile owners. At least one car owner in the United States has a twelve-cylinder aeroplane engine under his motor hood. The illustration at right shows a new type of aeroplane engine mounted for testing purposes on a motor truck. The engine turned the propeller fast enough to move the truck through the snow.

While the engine operates at more than two thousand revolutions per minute, the propeller is geared down to give a rotation of from 1000 to 1400 per minute. The arch enemy of lightweight motors is vibration. In the new motor vibration has been avoided. Every moving part is held secure and rigid. The camshaft is located next to the valves, situated on top of the cylinders, and with the rocker arms is enclosed in an oilbearing casing, thus granting it the same benefit that the crankshaft and connecting rods have from their casing.

Through an oil-tight joint the other ends of the rocker arms stick out into the open where the valve springs are best protected from heat. Every three of the twelve cylinders form a solid block, within which nothing can shake loose. The crankshaft is stout and short, owing to this "twin-six," V-shaped arrangement and to the connecting rod having forked wrists.

Lubrication by power (forced feed) insures an ample supply of oil. There is an angle of only forty degrees between the two sets of cylinders, thus insuring compactness and eliminating vibration. The cooling waterjackets are made extra long. The pistons have three rings to utilize every fraction of pressure. An electric starter makes it unnecessary to crank the motor by turning the propeller by hand, and gives full power control in the air. The motor furnishes two hundred horsepower. Yet the individual cylinders are only four by six inches, and a block of three weighs only forty pounds.



The truck was driven through heavy snow by the aeroplane motor and the propeller

The Ceiling Bed. It Never Shows Itself Until It Is Needed

THE problem of what to do with extra company when you have no guest room has been solved by the disappearing bed which is hidden in the ceiling. It is the latest addition to the large number of disappearing and folding beds of all kinds, but it differs in its construction from any bed which may come under the classification.

In the first place, it does not take up wall space, closet or floor space. It fits in the ceiling of the room, two false panels being used so that the place of concealment is always covered. When the bed is lowered to the floor one of the panels descends and covers up the opening, leaving nothing to suggest where the bed came from. The other panel, held below the bed, fits into the ceiling when the bed has been raised to its hidden day-time position in a box installed between the ceiling and the floor above.

The bed lowered. The space it occupies in the ceiling is covered by a false panel which drops into place

In oval: The bed fits into a box installed between the ceiling and the floor above

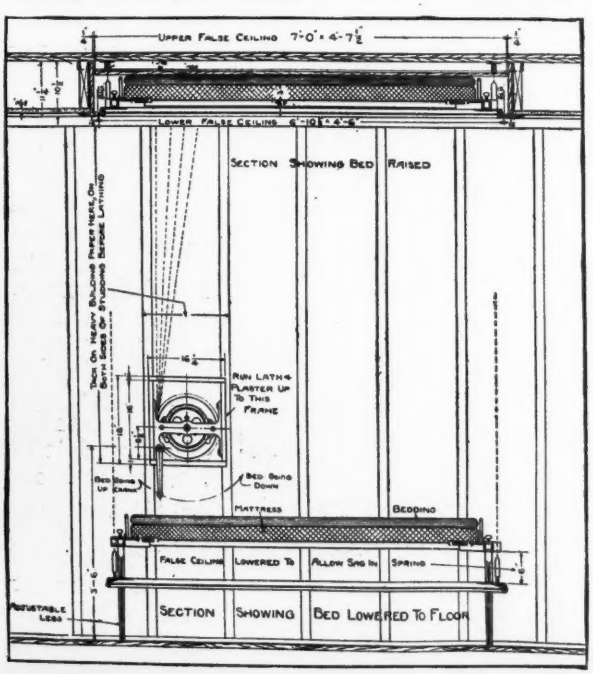


Diagram showing the plan of the ceiling bed, the location of the cables and the winding drum

Fitted in one of the side walls of the room is a winding drum around which are cables leading through the joists and fastened securely to the four corners of the bed. An inconspicuous door gives admission to the winding drum and by turning the crank the bed is raised or lowered into position, as desired.

In a cottage or small bungalow where usually the only paneled room is the dining room, the bed can be concealed from view at all times, except when it is lowered for use. It requires but a moment's time to raise or lower the bed and this can be accomplished with but little effort.

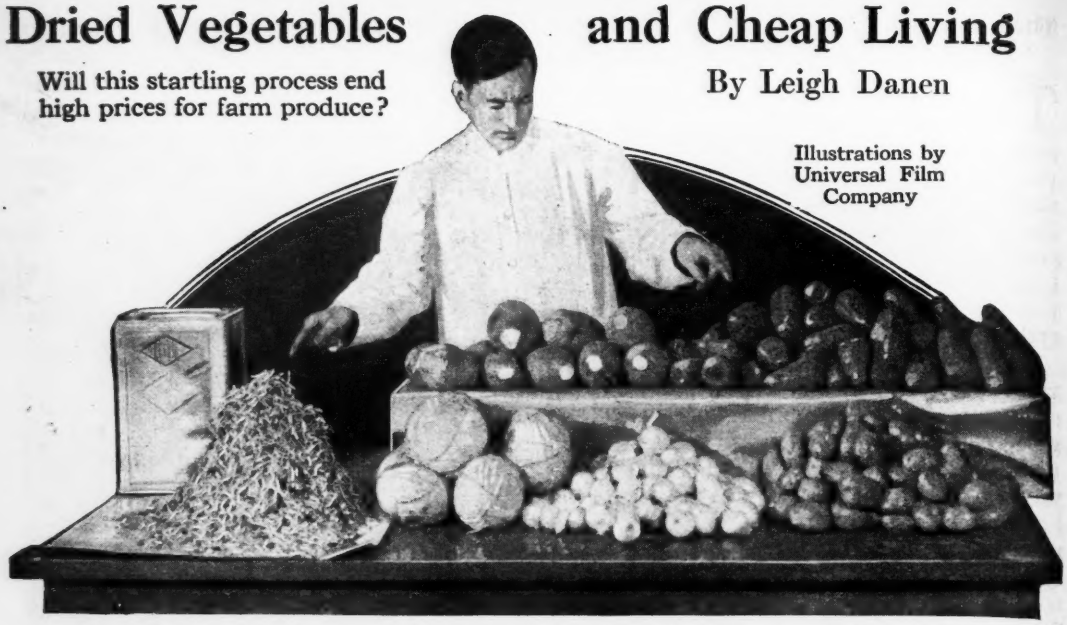
Such a bed is generally of three-quarters size and is equipped with comfortable springs and mattress. It is made up ready for use before it is sent skyward.

Dried Vegetables and Cheap Living

Will this startling process end high prices for farm produce?

By Leigh Danen

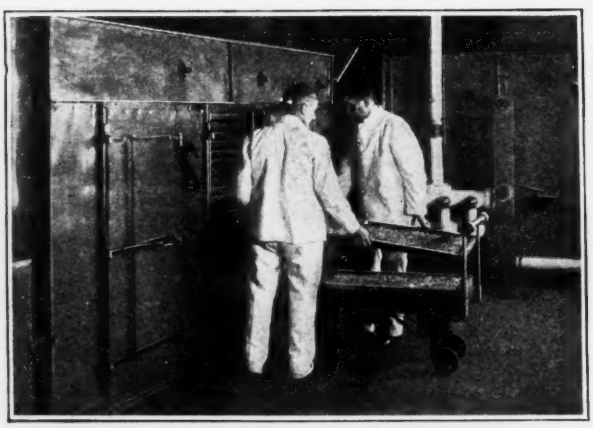
Illustrations by Universal Film Company



A pound of dried mixed vegetables prepared especially for soup, is sufficient for sixty adults. The vegetables are dried and shredded within eight hours after they are picked

A WONDERFUL method for conserving vegetables by drying has recently been perfected by three Americans. The new system is based on the fact that the micro-organisms which promote fermentation in vegetable matter, depend upon moisture in order to live and propagate. The problem, therefore, narrowed itself down to finding a way of removing as much of the water as possible from the vegetables which were to be preserved, of "dehydrating" them.

The greatest difficulty encountered was not in abstracting the water from, or drying, the food products, but in preserving intact their cell structure so that their original food value would not be lost. After more than five years of experimentation, this has been accomplished. It is now possible to reduce the percentage of moisture in vegetables to well within twelve per cent; by which process the development of bacteria is prevented.



The vegetables are sliced and then subjected to the action of heated air currents in ovens

The vegetables are first sliced and then brought into contact with heated air. Air at any given temperature can take up a certain definite maximum amount of moisture; this, under ordinary conditions, it finds no difficulty in extracting from its surroundings.

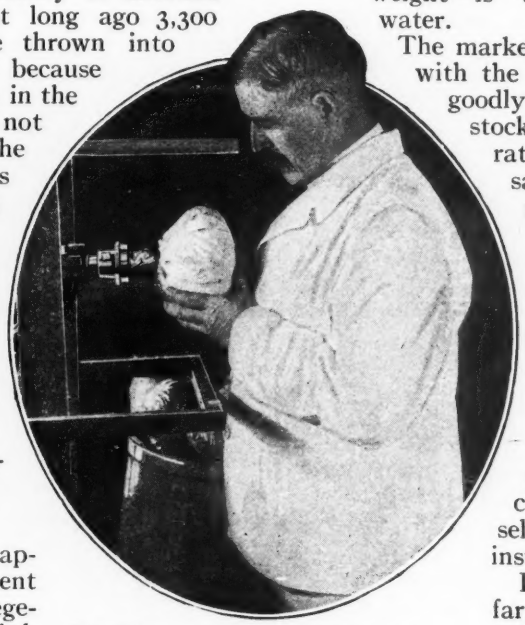
Heated air containing less than such maximum amount of moisture is introduced into a chamber where the vegetable matter which is to be dried has been placed. The water-seeking air then dehydrates this material almost completely.

The names of the three men who have developed this process are Waldron Williams, Woodford Brooks and Dr. F.G. Wiechmann.

Not more than fifty per cent of the vegetables grown in the United States ever reach the consumer. From the standpoint of the utilization of foodstuffs, this seems almost criminal. Many must have wondered whether somedaya method

would not be discovered whereby the surplus crop of fat years could be saved for use when demand required. This seems to be the process for the purpose.

An instance of the needless waste of vegetables in this country is afforded by the fact that not long ago 3,300 bags of onions were thrown into San Francisco Bay because they had deteriorated in the warehouses and could not be sold. This when the price of onions was soaring skyward at an unbelievable rate! Green vegetables will remain edible so long, and no longer. The ultimate consumer, and he alone, must pay for wastage.



Shredding a cabbage preparatory to relieving it of its 91.5 per cent water

When You Buy Vegetables You Pay for Much Water

It is not generally appreciated to what extent water enters into all vegetable matter. With wheat, for instance, twenty per cent is moisture. In other words, out of every five carloads of wheat, one represents water. Freight charges are paid on this as if it were nutriment. There is no rebate on the water contents of the foodstuffs carried by railroads and freight ships.

The ultimate consumer foots the entire bill when he buys his barrel of flour. Not only that, but the baker's loaf—sold by weight—is thirty-five per cent water.

The marketman has to contend with the same difficulties. A goodly percentage of his stock wilts and deteriorates, all because of the same trouble-breeding moisture. What he sells must therefore bring a price high enough to balance this loss.

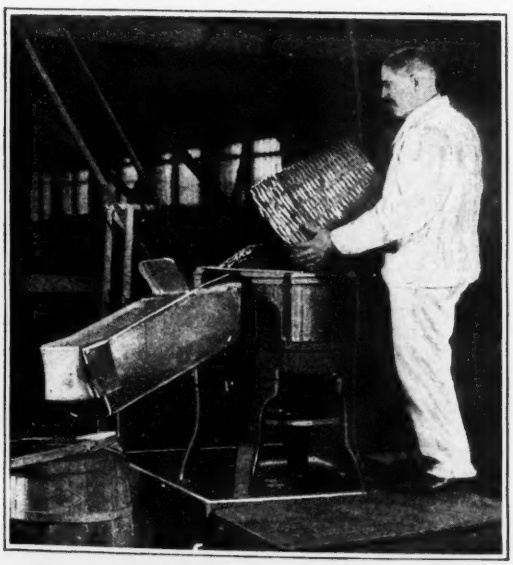
The wholesaler, also, is confronted by similar conditions. He has to pay charges for transportation, cover depreciation in transit, and sell at prices that will insure a profit.

Returning again to the farmer: He can ship only the very best of his produce in order that his perishable wares may stand reasonably well their journey to the markets. As a result, when his vegetables ripen overabundantly, he has to count as a loss that part of his crop which remains in his barn, and is forced to increase the price of his marketable goods accordingly.

Although consumers fume over the high price of fresh vegetables, they seldom realize these fundamental causes, which operate to bring it about.

When the Europeans turned their minds to conserving surplus farm products, they sought to imitate nature, which had taught primitive man how to keep food by drying it in the sun or by the heat of a fire. The great difficulty experienced by foreign scientists was that while heat dried vegetables brought into contact with it, it did not do so with any degree of uniformity.

To preserve vegetables, it is necessary to withdraw the moisture from their innermost recesses as well as from their exterior. Otherwise, deterioration will start and progress under the surface. Too great an amount of heat will bake the interior; and too little will leave the interior subject to mold and decay.

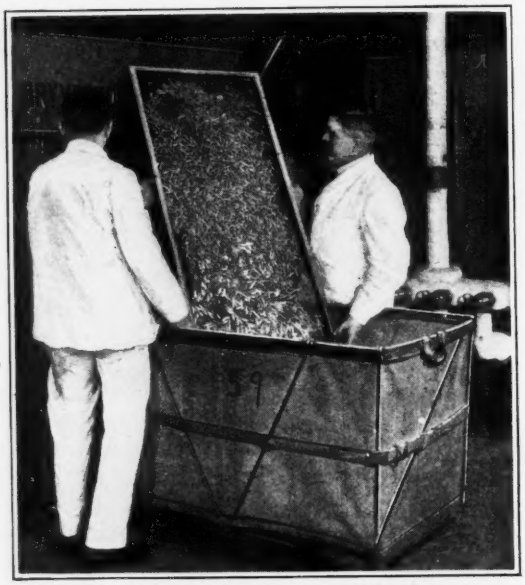


The water extracted from the vegetables in this machine runs off into the barrel below

So, to offset any incompleteness of drying, it was found advisable in other lands to cook the vegetables first, thus arresting by so much any tendency to spoil. Briefly, that method consists in parboiling the vegetables and then drying them sufficiently to prevent subsequent deterioration or fermentation. The latter step is accomplished with heat.

To prepare the great majority of vegetables dried in this way for table use, it is necessary to cook them. The dried farm products, already parboiled, thus must be recooked.

This is the main fault with the old method. Twice cooked vegetables are generally somewhat flat.



The bottoms of the frames used in the ovens are of screening to permit the passage of air

How America Attacked the Problem

Such was the status of vegetable preservation through drying when Waldron Williams and his associates took up the work in this country. Farm products were being dried abroad. But they were not as palatable as fresh vegetables. The task was to conserve them and at the same time, keep their food value and taste unaltered. This these men have succeeded in doing.

The American process as it now stands consists in utilizing heated air currents at relatively low temperatures, which serve to draw out, absorb and carry off the moisture in sliced vegetables while leaving them otherwise absolutely unimpaired.

The vegetables are first cut up but not parboiled or in any other way treated. Then they are subjected to the new moisture-extracting process.

The volume of the air currents and their temperature can now be controlled to a nicety, as a result of long and exhaustive investigation. The time required to dry farm products depends wholly upon the vegetables dealt with. The period of treatment ranges from two hours to about five; this can be readily appreciated if the varying moisture content of the different vegetables is taken into consideration.

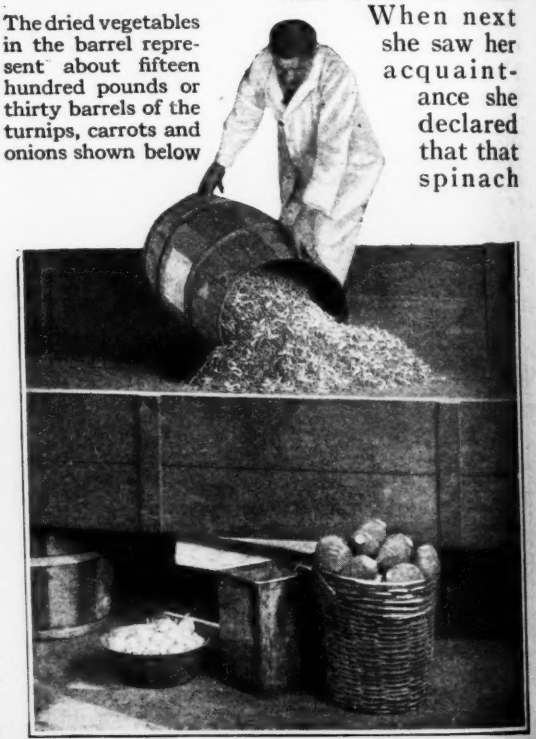
For instance, fresh beets contain 87 per cent of water; cabbages, 91.5 per cent; onions, 87 per cent; potatoes, 78 per cent; and tomatoes as much as 94.3 per cent.

The greater the volume of water present, the longer the drying operation must be maintained in order to reduce the moisture content to the desired minimum and at the same time dry the vegetables uniformly.

How well the new vegetable drying system works out, in the matter of retaining intact the natural flavor of fresh farm products, is evidenced by the testimony of a New York housekeeper, a friend of one of the scientists.

Merely to satisfy her curiosity, a package of dried spinach was sent to her. When next she saw her acquaintance she declared that that spinach

The dried vegetables in the barrel represent about fifteen hundred pounds or thirty barrels of the turnips, carrots and onions shown below



actually tasted fresher and better than the green stuff she was accustomed to purchase at her grocer's. That's just the key note of the new method. The spinach given to the housekeeper was dried inside of eight hours from the time it was picked, while that bought at provision stores is anywhere from two to ten days old and hence frequently stale.

Furthermore, the developers claim that products dried according to their system, can, in large quantities, be sold at a lower price than the actual retail market price of green vegetables. They are of the opinion that fresh vegetables will be formidable competitors of the dried products only in fat years. At such times, however, vegetables are purchasable at a low figure and the surplus will in all probability be dried to maintain a general balance in the green foodstuff market.

Wastes Can Be Utilized

Among the many products which are being successfully dried at present, and which otherwise would go to waste, are potato culls—that is, potatoes which have been injured in digging and therefore are below market standards. At least ten per cent of the potato crop falls into this class. This percentage is now being dried and converted into potato flour.

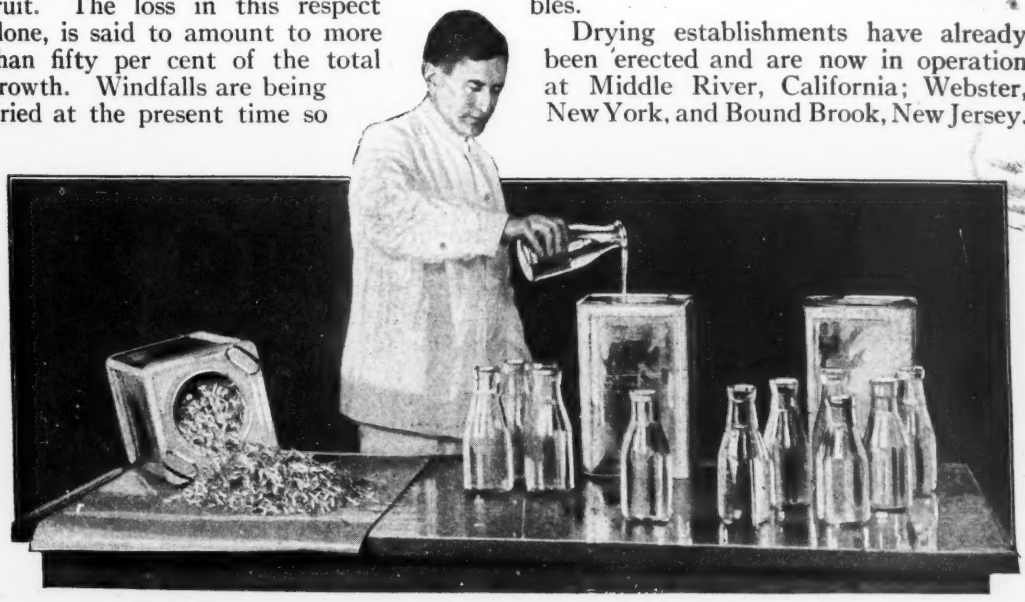
Windfalls in fruits offer another important field for conservation. The market usually insists upon hand-picked fruit. The loss in this respect alone, is said to amount to more than fifty per cent of the total growth. Windfalls are being dried at the present time so that they can be used in many ways. Powdered dry orange is as fragrant as the fresh fruit. So, also, are a number of other fruit flours.

A pound of dried mixed vegetables made up of carrots, turnips, onions, cabbage and potatoes, prepared especially for soup, is sufficient for sixty or more adults. A barrel of the same vegetables weighing one hundred pounds, provides enough soup stock for nearly six thousand persons. The raw vegetables which go to make up this mixture, before drying fill thirty barrels and weigh in the neighborhood of one thousand, five hundred pounds.

The food ratio between the dried and the original green vegetables is as follows: Potatoes, 1 pound to 7; cabbage, 1 to 18; onions, 1 to 13; spinach, 1 to 14; carrots, 1 to 12; and turnips, 1 to 13.

I dropped a few slices of dried onion into a glass of water; the slices were about the thickness of a postage stamp. In less than an hour they had absorbed enough water to assume the size, shape and odor of the original onion slice. Strips of carrots, after they had been soaked, regained their original shape and became as firm as the fresh vegetable. Spinach which looked like pressed flowers, bloomed into a brilliant green after a few minutes in water, each leaf intact with its network of raised veins as if it had just been gathered from the field. No inferiority could be detected in the flavor of these vegetables.

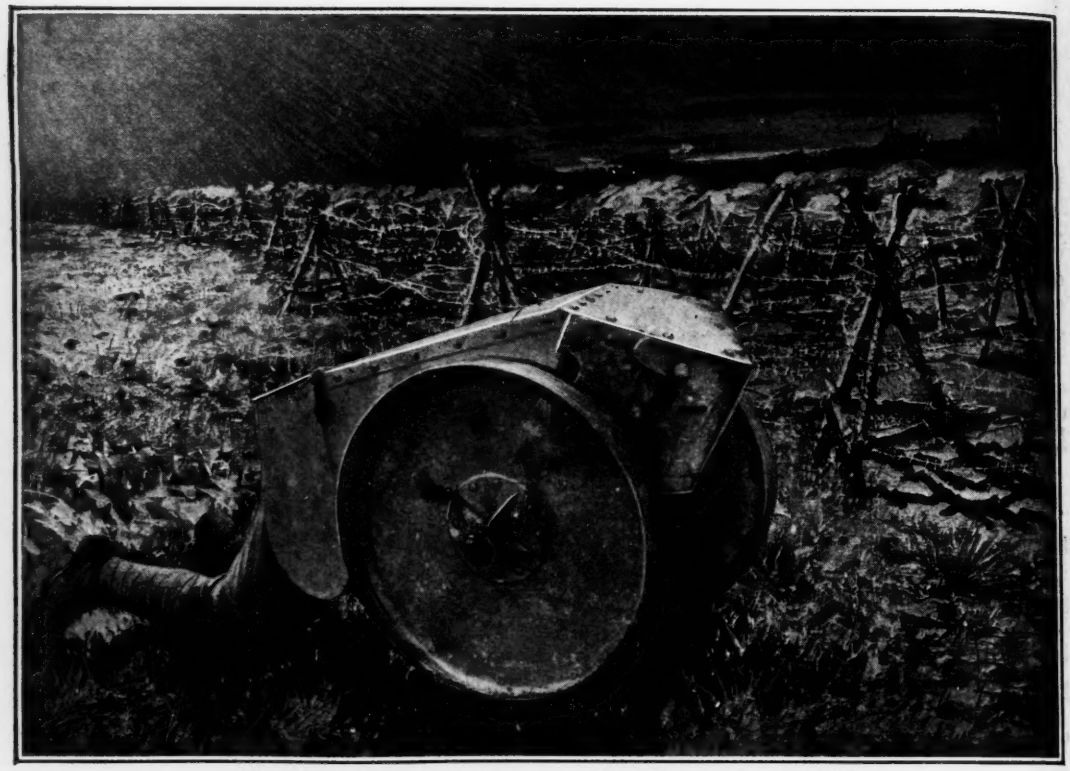
Drying establishments have already been erected and are now in operation at Middle River, California; Webster, New York, and Bound Brook, New Jersey.



The bottles and glass tanks at right of photograph contain an amount of water equal to that which was extracted from the dried vegetables at the left

Cutting Barbed Wire in the Single-Man Tank

In this steel tank resembling a broken and discarded cannon a scout can creep over the ground unsuspected



The wire-cutter in the one-man tank creeping cautiously to his task of destroying the wire entanglements set up by the enemy

WE hear comparatively little of the work done by the scouts of the army. And yet they are called upon to take risks which the rank and file seldom dream of, acting often on their own initiative and unprotected in exposed territory.

They have well been called the "nerves" of the army, and it is high time that the genius of the inventors should be directed toward them. In the illustration above is shown a device which has been employed by the French to enable the individual scout to make his way over exposed country and to find out the lay of the land under cover, to a certain extent.

The device is made to resemble a cannon which it is hoped will be considered by the enemy to be broken and discarded. It is provided with slits and larger openings through which the scout may see and get air. The wheels, though apparently rusty and old, are smooth-running and noiseless, and the legs of the scout, moving cautiously at the rate of perhaps one-half inch per minute during critical times, resemble the drooping muzzle of the gun—or it is hoped that they will.

It is also considered among the possibilities that the device will be of service when it is necessary for a bold and death-defying dash to be made through showers of shrapnel into the teeth of the foe. But this is problematical since the device is not made for rapidity of movement.

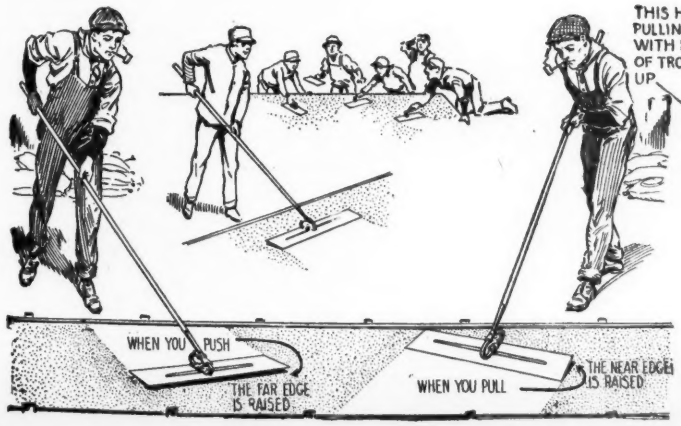
The chief advantage to which it has been put thus far is to protect the soldiers whose duty it is to cut down the wire entanglements set up by the enemy. Heretofore the wire-cutter's life has been a poor risk for the insurance companies. Even under such protection as this tank-shield affords, his is not the easiest of tasks. His one chance lies in concealment, therefore such a device as this, in which he may creep forward or backward, slowly but surely, may prove to be his salvation.

New Long-Handled Trowel Saves Cement Finisher's Time

THERE is no need to break your back or to use pads or boards to protect your knees when you are finishing a cement sidewalk. Use the long-handled trowel shown at the bottom of this page. This tool differs from that generally used for finishing work, in that it has a long, broom-like handle which is attached to the face of the trowel itself. The lower end of the handle is pivoted in the center of a short bar with toggle members at each end attached to a second bar pivoted by nut and bolt to a U-shaped piece of metal laid on its side and rigidly attached to the face of the trowel.

The double motion secured through the use of the two pivoted bars and the connecting toggle arms causes the near edge of the trowel to raise when pulled toward the workman and the far edge to raise when pushed away from him. Thus is overcome the difficulty occasioned by the tool's digging into the surface.

In ordinary work it is said that one man with such a long-handled trowel can finish as much surface as five or six men with the usual tool and knee pads.



One man can compete with six using the usual trowel and knee pads

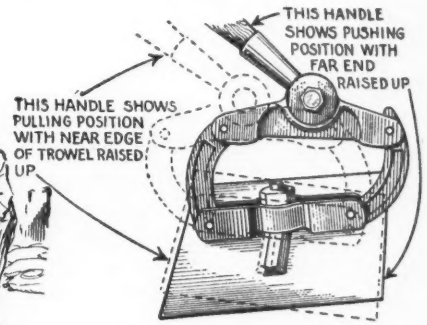
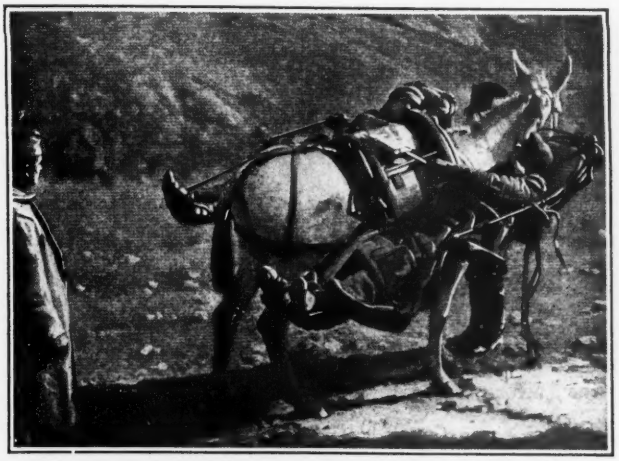

THIS HANDLE SHOWS PUSHING POSITION WITH FAR END RAISED UP
THIS HANDLE SHOWS PULLING POSITION WITH NEAR EDGE OF TROWEL RAISED UP

Diagram showing the double motion secured by the two bars and toggle arms

The Army Mule Comes Into His Own as a Mountain Ambulance

IN spite of the fact that Science and Invention are constantly devising new means of alleviating suffering and especially of affording comparative comfort to wounded soldiers, there are times when the old, old methods are resorted to as the best available. In the accompanying photograph, for instance, the army mule is shown taking precedence over the automobile ambulance, and all other modern devices, as the most humane means which the Red Cross workers could employ for transporting the wounded from the scene of battle in the mountains overlooking the plain of Monastir.



Two wounded soldiers, one a Serb and one a Bulgarian, being conveyed by the mule-ambulance through the narrow mountain passes to the railroad station

The stretchers were attached, one on each side of the mule, with the heavy yoke-saddle between. The mule, gingerly picking his way, could go where the automobile could not—right out into the midst of the prostrate forms and through the narrow mountain passes in the bend of the Cerna river, where the Serbs made their great play, and on to the railroad from Salonika.

Who Won the $50 Prize

The Popular Science Monthly's automobile-naming contest was a close one. There were several hundred contestants. The prize of $50 was awarded to Herman F. Lippe, of New York. While seventy-eight contestants gave the names of the cars correctly, he gave the best reasons for the adoption of the features shown in the photographs that we published. Below are the winner's answers.

1. PACKARD twelve-cylinder motor, characterized by great power per unit of weight due to small cylinders with light pistons; short length due to cylinder placing; even power application due to frequency of cylinder explosions and small vibration due to light reciprocating parts. It is identified by removable cylinder heads for ease in cleaning; hot water-jacketed intake manifold to heat incoming gases for better carburation and use of lower grade fuel; removable water jacket plates for cleaning and silent chain camshaft and generator drive for quietness. Crankcase fins cool motor oil. Cooling water under thermostatic control for motor efficiency.

2. Cab of the PACKARD twelve-cylinder car, identified by brake and gearshift levers on left and separate control box on steering column under wheel. The control box mounts the carbureter adjustment, switches for vehicle lights and ignition switch which must be turned before motor can be started. This control arrangement is convenient for driver who does not have to reach forward to dash panel or take his eyes off road in dimming lights. Car is also identified by ventilating cowl to admit air desired. Windshield is adjustable to suit weather conditions. Gasoline pressure feed pump on steering column is convenient.

3. The LOCOMOBILE seven-passenger touring car is identified by distinctive headlights with dimmer lamps in rectangular recesses at top for city driving. No other car has headlights of just this shape. Shape is for distinctiveness and integral construction for economy as small side lamps are unnecessary. Note pleasing shape of engine hood and graceful joining with body. Note tool compartment doors in running board apron for convenience and rear tonneau step light to prevent mis-step at night. The high body sides keep out much dust in touring, while comfort is obtained by deep upholstery.

4. STUTZ touring car showing low body, extreme pitch of steering wheel and low driver's seat. The low-sided body gives style and a low center of gravity for safety and speed, a characteristic of the car. Low driver's seat and wheel position are for comfort. The outside horn enables it to produce a louder noise. The windshield braces strengthen it at high speeds against breakage. They also make windshield end bars stronger to support top. Center cowl with compartments for gloves, etc., is convenient. The aluminum band between body and hood adds distinction of no practical value.

5. Tonneau of the LOCOMOBILE touring car, distinguished by shape of front seat and upholstery for comfort; large door handle for ease in opening and two auxiliary seats which fold into a recess in the rear of the front seat when not in use. Seat supports give plenty of leg-room for rear seat passengers, for comfort when touring. Supports are out of way in floor recesses when seats are not used, giving plenty of room in tonneau without floor obstruction. This is also a comfort-giving detail. Large tonneau door also makes for ease in getting in or out.

6. The PIERCE-ARROW, distinguished by integral headlights and fenders for distinction; the graceful fenders for beauty and the ventilators in hood top to allow heat given off by motor to escape. The integral headlights are optional equipment. They permit free access of air to full radiator front; outline width of car at night; throw light in path of wheels but are difficult to repair when fenders are bent by collision, sometimes due to extreme overhang when turning sharp corners. The heat through hood top is deflected by windshield which is kept clear of snow due to melting.

7. SCRIPPS-BOOTH car, showing radiator with V-shaped front for distinctiveness, less wind resistance and greater cooling space for engine; short hood and long cowl with unusual yet pleasing angle break between curvature of cowl top and side. Note the low frame and body for lower center of gravity and safety in driving. Notice outside door handle for easy opening and rake of steering wheel for staggered driver's seat. Due to narrow width of the small car, staggered seats are employed for roominess and comfort. In the roadster model, a detachable stool seat is employed for the third passenger.

8. Distinctive radiator and power plant of the OWEN-MAGNETIC. A six-cylinder gas engine is incorporated with an electro-magnetic clutch to transmit the power to the rear wheels by magnetic lines of force through an air space. The propeller shaft has no mechanical connection with the engine and cannot transmit shocks. This driving method eliminates the conventional gearset, flywheel and clutch, and their levers, and the starting and lighting units. Any number of speeds may be obtained by varying the slippage of the electric clutch. Smooth running and extreme ease of operation are features.

9. The STUTZ four-cylinder, sixteen-valve motor, identified by the two-bladed aluminum aeroplane radiator fan which is lighter than the usual three-bladed type to perform the same work. Two intake and exhaust valves on each cylinder enable high motor speeds and greater power to be obtained by quick gas ingress and egress. Two small valves instead of one large one give less warpage due to heat, less wear due to lighter springs necessary, and less occasion for regrinding. Note the ribbed exhaust manifold to radiate heat of gases because of high speeds.

10. The MARMON car showing the unusual frame construction in which the vehicle frame and running board riser are integral and combined with aluminum running board and fender. This construction makes for lightness and resultant low cost of operation and besides eliminates squeaks and rattles between usual frame and riser. The three-part body is mounted directly on the frame without sills, giving low center of gravity and easy riding. Car is distinguished by horizontal joint between fender and running board, and is featured by aluminum cylinders with steel inserts for lightness to save tires and fuel.

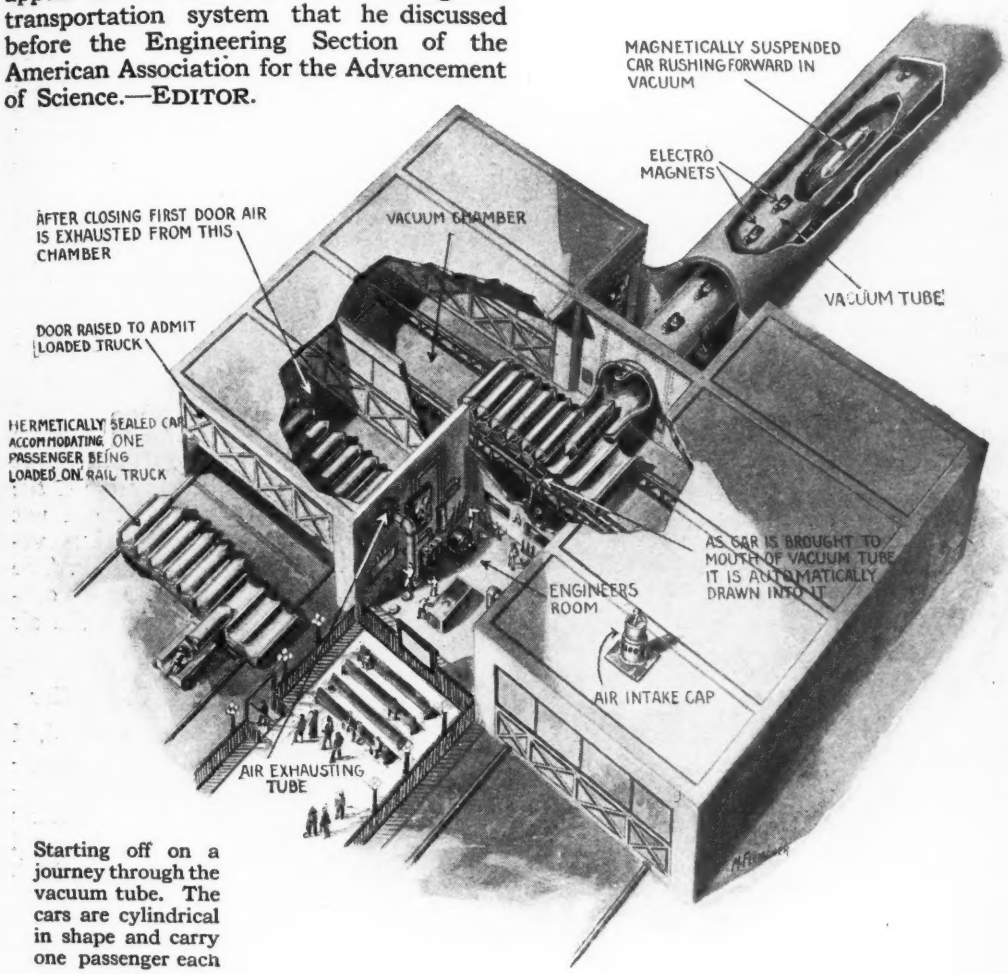
Five Hundred Miles an Hour

An electromagnetic method of transporting you through a vacuum from New York to San Francisco in half a day

By Boris Weinberg

Professor of Physics in the Technological Institute of Tomsk, Siberia

Professor Weinberg prepared the following article for POPULAR SCIENCE MONTHLY at the editor's request. It is the only one he has permitted to appear on the remarkable electromagnetic transportation system that he discussed before the Engineering Section of the American Association for the Advancement of Science.—EDITOR.


MAGNETICALLY SUSPENDED CAR RUSHING FORWARD IN VACUUM
ELECTRO MAGNETS
VACUUM CHAMBER
AFTER CLOSING FIRST DOOR AIR IS EXHAUSTED FROM THIS CHAMBER
VACUUM TUBE
DOOR RAISED TO ADMIT LOADED TRUCK
HERMETICALLY SEALED CAR ACCOMMODATING ONE PASSENGER BEING LOADED ON RAIL TRUCK
AS CAR IS BROUGHT TO MOUTH OF VACUUM TUBE IT IS AUTOMATICALLY DRAWN INTO IT
ENGINEERS ROOM
AIR INTAKE CAP
AIR EXHAUSTING TUBE

Starting off on a journey through the vacuum tube. The cars are cylindrical in shape and carry one passenger each

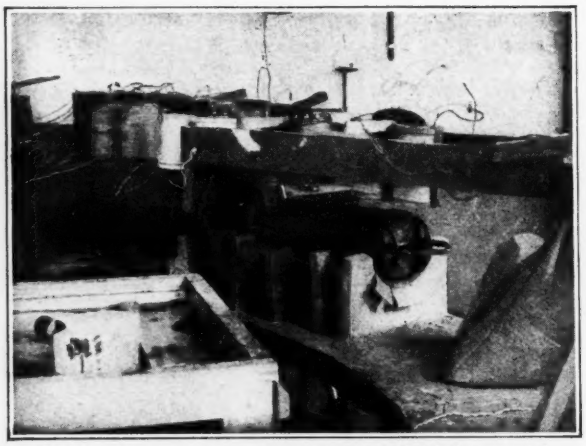
LIGHT travels at the rate of one hundred and eighty-six thousand miles a second. That is the highest velocity that theoretically can ever be attained not only by any material bodies, but even by isolated electrons—atoms of electricity. In comparison, racing aeroplanes which are credited with speeds of one hundred and fifty miles an hour, seem snail-like. The fastest artificial thing is a bullet as it leaves the muzzle of a rifle, although its speed is only three thousand miles an hour. Small as that is when compared with the velocity of light, still it proves that the railway train and the aeroplane by no means represent the limit of terrestrial possibilities.

To attain speed, however low, energy must be expended not only to start the motion of a body but to overcome the resistance of the air and friction against the train caused by gravitation. The resistance

of the air manifests itself more and more as speed is increased, so that each additional mile-an-hour of speed is purchased at additional waste of energy. Gravitation is constant. It pulls a moving object down to the earth, and sooner or later stops it.

How You Can Travel for Nothing

It is apparent that if we are to attain and maintain anything like the speed of a bullet we must remove the air and we must neutralize the attraction of gravitation, since it cannot be destroyed. If this is attained you need not expend energy to maintain the value of the velocity of the car—the principal waste of energy in all usual systems of locomotion—and you could travel indefinitely for nothing.



In his laboratory experiments, Prof. Weinberg used a copper tube ten inches in diameter, curved so that it returned into itself. The "car" is shown here — an iron cylinder running on wheels

A consideration of the subject led me to conduct laboratory experiments which show that it is possible to move a car at high speed in a tube from which the air has been partially exhausted—thus overcoming the obstacle opposed by air resistance—and to support that car, not on the usual rails but literally in space by means of electromagnets—thus neutralizing gravitation.

In these laboratory experiments I used a copper tube ten inches in diameter curved so that it returned into itself. The straight portion was wrapped with a long coil of insulated wire divided into sections to constitute as many solenoids—electromagnets without iron cores. By manipulating a system of switches I could send the current through these solenoids in rapid succession. The "car" was an iron cylinder running on wheels. It was magnetically sucked into the influence of the first solenoid, then into the next and in this way successively passed from one coil to the next. When the car had attained a velocity of four miles an hour in my experiments and was passing out of the influence of the last solenoid the current began to flow through the first. All the solenoids were placed on top of the copper tube and served to raise the car from the bottom of the tube. When this current was too weak the car would jump just slightly from the bottom of the tube; when it was too powerful the car would actually scrape the top of the tube and run touching, not the bottom but the "ceiling" of the tube; and when the current was of just the proper strength the car rose from the ground without touching the top wall and sped on to another electromagnet which, in the same way, kept it thus suspended in space. Every electromagnet was energized only during the time that the front of the car began to approach it and until the rear of the car had passed it. In this way the electromagnet merely lifted the car but did not change its velocity at all. The tube was connected with an air pump so that the air could be practically exhausted.

You Are the Only Passenger in the Car

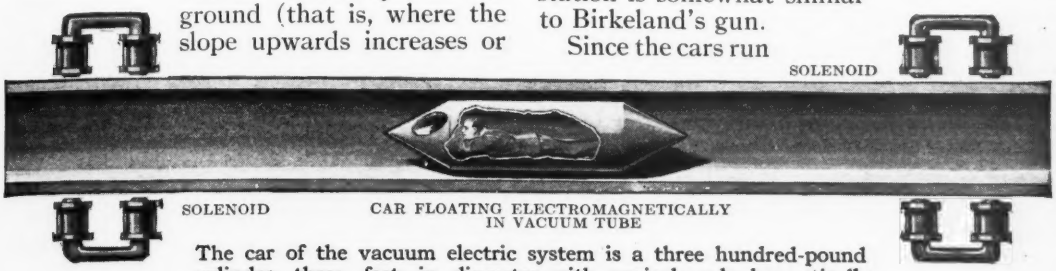
In imagining this principle applied, I must ask my readers to divorce themselves from all current conceptions of railways. The car of the vacuum electric system would be a three hundred pound iron cylinder three feet in diameter, with conical ends hermetically sealed. You enter that car and lie prone in it, its solitary passenger. The sustaining electromagnets are much bigger than those used in my experiments shown in the photographs, and they are spaced thirty feet apart and are successively fed with a powerful current for a fraction of a second.

The direction of motion of such a high-speed car cannot be easily changed. Imagine the difficulty of swerving a fifteen-inch projectile as it leaves the mouth of a naval gun! Like any railway the vacuum tube would have its curves. How are they to be rounded? I again utilize electromagnets. The distance between these electro-

magnets depends on the degree of curvature and their total number on the angle at which the curve is entered and left by the car.

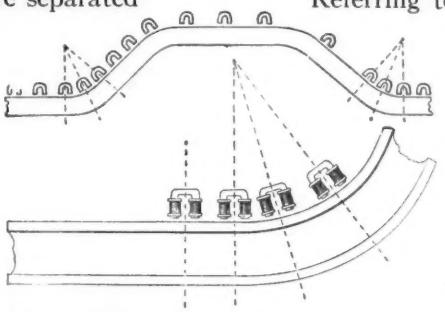
Rounding Curves at Five Hundred Miles an Hour

But the tube will be curved not only horizontally, like an ordinary railway: it will sometimes be bent up and sometimes down, as the nature of the country demands. In the part of the tube where it is convex relatively to the ground (that is, where the slope upwards increases or the slope downwards decreases) the sustaining electromagnets must be closer together than over the straightaway portions. Where the tube is convex relatively to the sustaining magnets they are separated by relatively greater distances.



The car of the vacuum electric system is a three hundred-pound cylinder three feet in diameter with conical ends hermetically sealed. You lie prone within it—its solitary passenger. There is no track. The car is really a free body sustained by electromagnets which are placed thirty feet apart

It is evident that the car is really a free body and as such it must gradually accentuate every departure of the rectilinear progressive motion. Since it is intended to travel at a very high speed, even the slightest change of the direction of motion or any rotation must be controlled so that it may not be wrecked. Even ordinary railway trains run off the track often enough. Here is a car which has no track but which should never be permitted even to touch the walls of the vacuum tube lest it be destroyed. Special devices must obviously be employed to prevent the car from swerving from a normal course. They would serve to energize supplementary electromagnets which would return the car to its proper course. It is superfluous to describe these supplementary safety devices in detail here.



The direction of motion of a high-speed car cannot be easily changed. But like any railway, the vacuum tube must have its curves. Electromagnets are placed at the proper side of the tube and spaced according to the degree of curvature

The Strange Stations that Must be Built

A long series of solenoids thrown into circuit when the front of the car approaches them and out of circuit when the middle of the car has passed their middle point constitutes the essential feature of a station which must be used by departing passengers. Professor Christian Birkeland, the distinguished Norwegian physicist, invented an electromagnetic gun, some years ago, in which the projectile was drawn forward by electromagnetic attraction. My station is somewhat similar to Birkeland's gun.

Since the cars run in a partial vacuum it follows that the passengers cannot pass into and out of normal surroundings without the aid of something like an airlock.

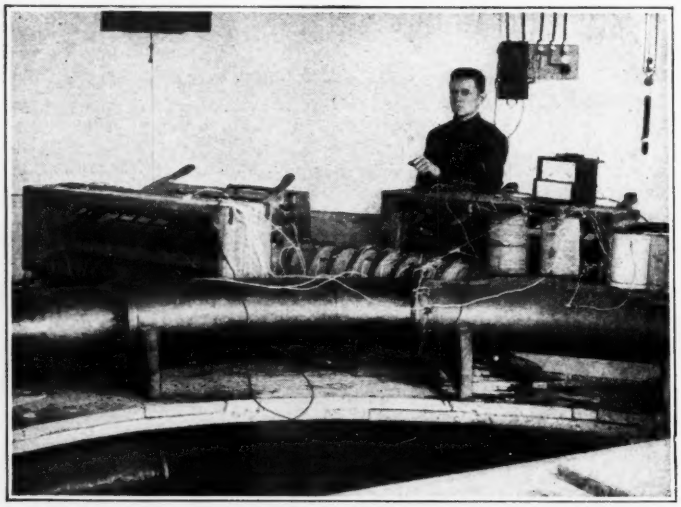
Referring to the accompanying diagram in which an airlock station—used only for departing cars—is depicted, it will be seen that there is a main chamber which communicates with the vacuum tube at one end. At this end a series of solenoids are mounted, and between are placed sustaining electromagnets. The main chamber is successively put in communication with several side airlocks which are used to increase the frequency with which cars may be started off in the tube. In the main chamber is a platform on which cars from the side airlocks may be rolled and which is moved on rails. When a car is just in front of the opening of the tube it automatically turns on the current of the first solenoid and is sucked into the tube. Thus car after car is drawn from the traveling platform at a rate which I have calculated may be as high as twelve a minute, the whole

proceeding being not unlike that of feeding cartridges from a belt or clip to a machine-gun.

A Car Can't Be Safely Stopped in Less Than Two Miles

The stations at which the cars arrive are similarly constructed. Each solenoid is energized at the moment when the middle of the car has passed its middle and is de-energized when the rear of the car has passed through. The stations must be some two miles long in order that the cars may be stopped gradually.

What will be the speed of such a system? My experiments have given me the data necessary to calculate the amount of attraction between the core of an electromagnet and an armature separated at a considerable distance from it, so that I have been able to fix the maximum speed attainable. That maximum depends on the maximum attractive force of the electromagnets which can be developed to overcome the centrifugal force on the curves.



This is the experimental apparatus which Prof. Weinberg used in working out the details of his proposed electromagnetic vacuum system of passenger transportation

Assuming electromagnets of reasonable size and currents of reasonable strength I found on the basis of my aforesaid experiments that with curves having a radius of two thousand feet it would hardly be possible to attain a speed of more than five hundred miles an hour. But think what that means! New York would be no more distant from Chicago than it is now from Philadelphia, so far as relative times are concerned. Florida might easily become a kind of winter Coney Island for all New York. A journey from New York to San Francisco would occupy only half a day.

Lifting an Ordinary Train off the Rails

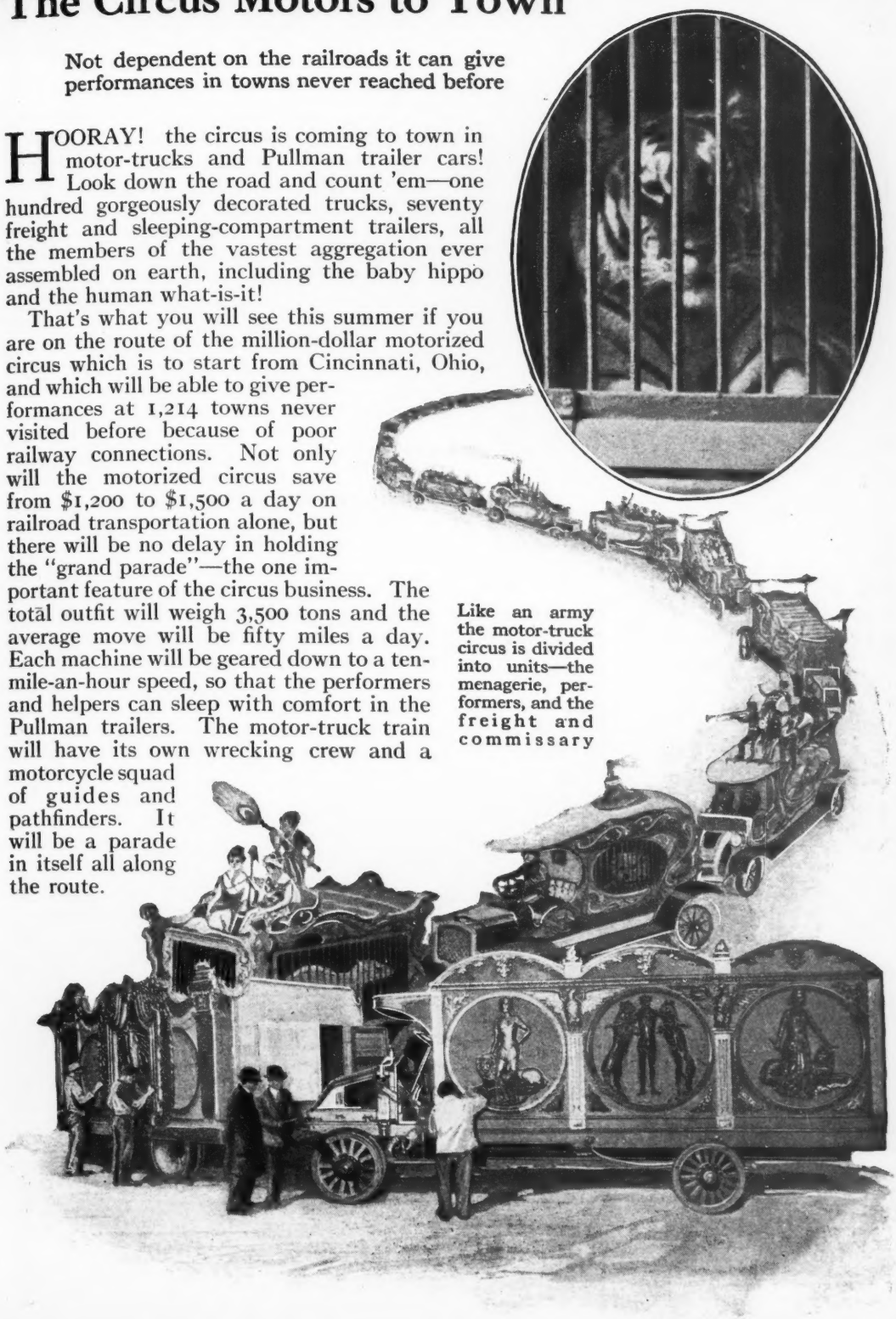
While the vacuum tube is an electrical possibility, it is more likely that some method of transportation proposed here, or one like that proposed by Emile Bachelet a few years ago, will be more seriously considered first. Bachelet did not propose the propulsion of a car in a partial vacuum so as to cut down air resistance, but he did propose the idea of overcoming gravity by the use of alternating-current electromagnets. Every amateur electrician knows that an electromagnet through which an alternating current is passed has the curious property of repelling a light metal object brought near it. Bachelet intended to build his cars with aluminum bottoms. When the cars ran over the magnets successively they were to be repelled—literally lifted off the rails. The system is objectionable because very much power is wasted per mile (contrary to my system where the waste of energy is insignificant) and the passengers would be very uncomfortably heated by the action of the currents from below. In my opinion an electric system, such as that which I have here outlined, but without the vacuum tube and with approximate (not complete) neutralization of gravity would be safer, cheaper, and simpler. The loss in speed due to the resistance of the air would not be excessive if the cars were properly designed, and might be compensated for by cutting the electromagnets out just as the front of the car left them one after the other. In this way the electromagnets would not only sustain the car but would also accelerate its speed. Moreover it would be much simpler to run on wheels instead of moving freely through space, gravity being only so far neutralized that the wheels would barely touch the tracks and a pressure would be exerted that would be almost negligible.

The Circus Motors to Town

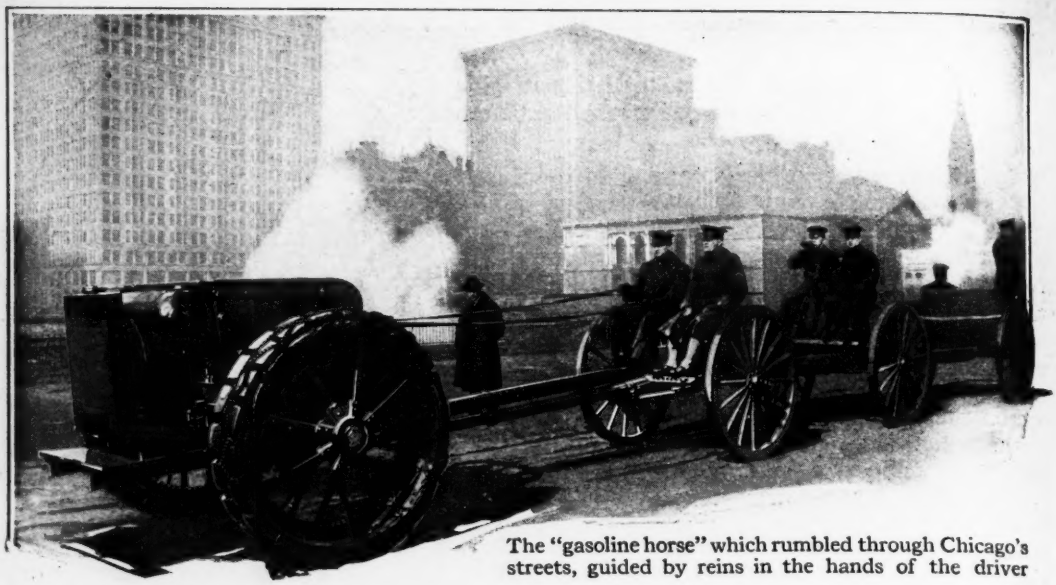
Not dependent on the railroads it can give performances in towns never reached before

HOORAY! the circus is coming to town in motor-trucks and Pullman trailer cars! Look down the road and count 'em—one hundred gorgeously decorated trucks, seventy freight and sleeping-compartment trailers, all the members of the vastest aggregation ever assembled on earth, including the baby hippo and the human what-is-it!

That's what you will see this summer if you are on the route of the million-dollar motorized circus which is to start from Cincinnati, Ohio, and which will be able to give performances at 1,214 towns never visited before because of poor railway connections. Not only will the motorized circus save from $1,200 to $1,500 a day on railroad transportation alone, but there will be no delay in holding the "grand parade"—the one important feature of the circus business. The total outfit will weigh 3,500 tons and the average move will be fifty miles a day. Each machine will be geared down to a ten-mile-an-hour speed, so that the performers and helpers can sleep with comfort in the Pullman trailers. The motor-truck train will have its own wrecking crew and a motorcycle squad of guides and pathfinders. It will be a parade in itself all along the route.



Like an army the motor-truck circus is divided into units—the menagerie, performers, and the freight and commissary



The "gasoline horse" which rumbled through Chicago's streets, guided by reins in the hands of the driver

A Gasoline Horse Which Is Guided With Reins

AN entirely new type of gasoline "war horse" was driven through the streets of Chicago recently. It was a two-wheeled gasoline tractor controlled by two reins like those of a harnessed horse.

The "gasoline horse," it is said, could be loaded with dynamite and guided across "No Man's Land" with reins a thousand yards long, and exploded in the enemy's country, while the driver remains at a safe distance. The principle is the same as that of the torpedo car, described in the April POPULAR SCIENCE MONTHLY.

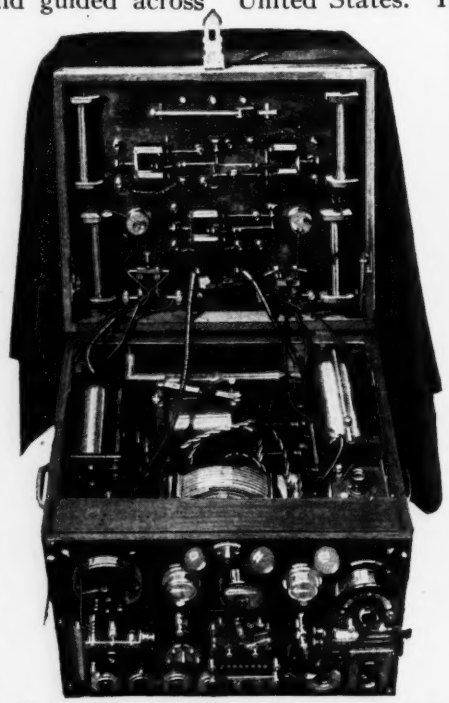
The exhibition of the machine was made by army officers conducting a campaign for recruits in the city. A three-inch field gun and several caissons were drawn behind it, the driver being seated on a caisson at a conspicuous distance from the "horse" so as to be able to show off the virtues of his "steed" to the best advantage. The machine responded to his lightest touch.

"Making Money" By Wireless—A Counterfeiter's Scheme

THE latest alleged "wireless" swindler is Max Hans Ludwig Wax, whom the New York police have recently arrested.

Our photograph shows Wax's "Money Making Machine," with which he is said to have mystified his victims throughout the United States. It is easy to see how the flashing of frosted lamps on the box-front, together with the humming and crackling of the rotary and fixed spark gaps, the sputtering of the relays and their choke-coils, and the complex adjustments of many switches, tuning coils, condensers and potentiometers would puzzle even a self-styled "expert." In the box is a miscellaneous collection of meters, coils, switches and other instruments, sufficient to transmit messages for twenty or thirty miles and to receive from much greater distances.

The radio instruments were probably mere "blinds" to make the strongest impression upon the gullible victims.



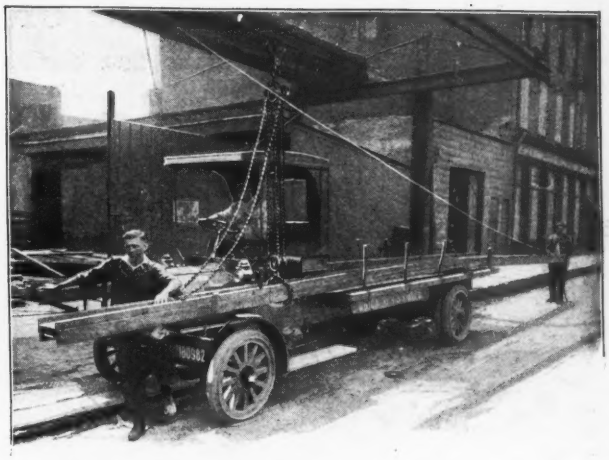
The wireless outfit used by the alleged swindler Wax as a "blind" to impress his victims

Fire-Escape Chutes for School Children

SOME of the California schools are equipped with novel fire escapes, which are not only a safeguard, but afford the children as much amusement as a regular playground equipment. One of these fire-escapes in Tropico, near Los Angeles, consists of several long sheet-metal chutes, reinforced with angle iron and secured to the walls of the building. They extend from an iron platform on the second floor, which leads from the main corridor. Separate chutes are provided for the boys and girls. The teachers encourage the use of the slides as an amusement to accustom the children to them. Each slide ends in a slight upward curve, to check the momentum of the descent. At the point where the children reach the ground a pile of loose sand breaks the fall.

In Venice, California, a spiral chute is employed, which is enclosed in a cylindrical metal casing. This is entered from a platform leading from the upper story. Like the straight slide, it is used as an amusement device by the pupils. A local hospital makes use of one of the same design.

The chute is used as an amusement device during recess periods in order to accustom the children to it



Instead of backing up against the curb, the truck draws up lengthwise and is loaded from an overhead movable beam

Loading a Truck Without Interfering with Traffic

THE novel motor-truck loading device shown in the accompanying illustration makes it possible for a vehicle to be loaded across the sidewalk without interfering with pedestrian traffic. This is accomplished by means of a movable beam mounted on rollers running on the side members of the framework, which extends out beyond the curb line at points about twelve feet above the ground.

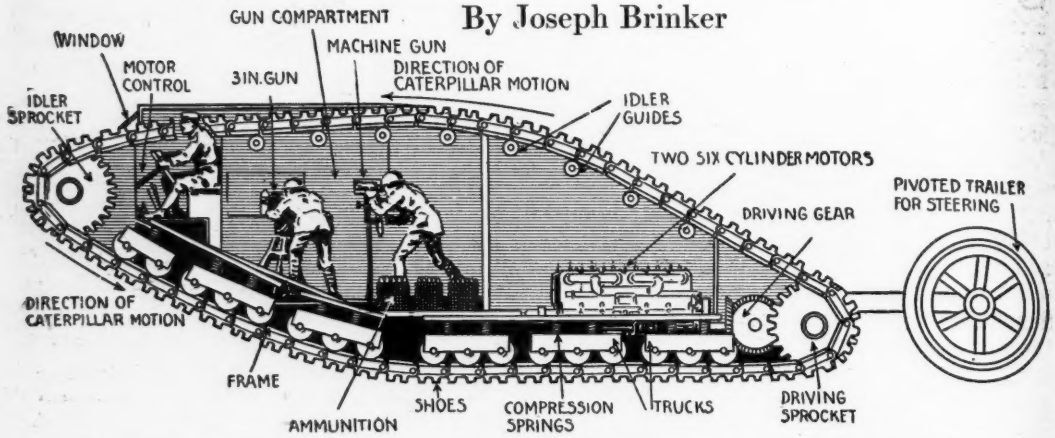
A conventional differential block and fall mounted on rollers on the movable beam is used to pick up the lengths of steel shown in the picture. When each piece of steel is attached to the block and fall it is hoisted up to clear the top of the motor-truck cab if it is to be loaded on the side of the truck farthest from the curb. It is then pulled out from the yard at the point of loading to directly above the truck body by means of a guy rope and lowered.

This method not only eliminates interference with pedestrian traffic but with vehicular travel as well, for the truck draws up to the curb lengthwise instead of backing up in the usual manner.

What's Inside of a "Tank?"

Here we have the first account of the construction of the famous revolutionary land dreadnoughts

By Joseph Brinker



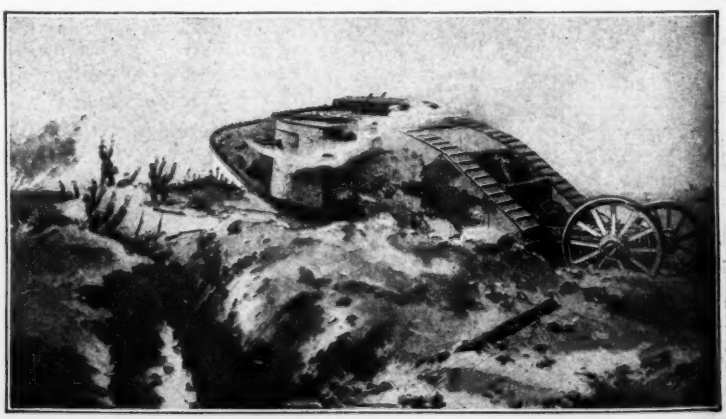
Inside of a caterpillar tank, showing the stations of the crew and the propelling mechanism

THE tanks! What new worlds of fear and wonder these British juggernauts of the battlefield opened up as they ponderously shoved their noses toward the enemy's trenches on the Somme!

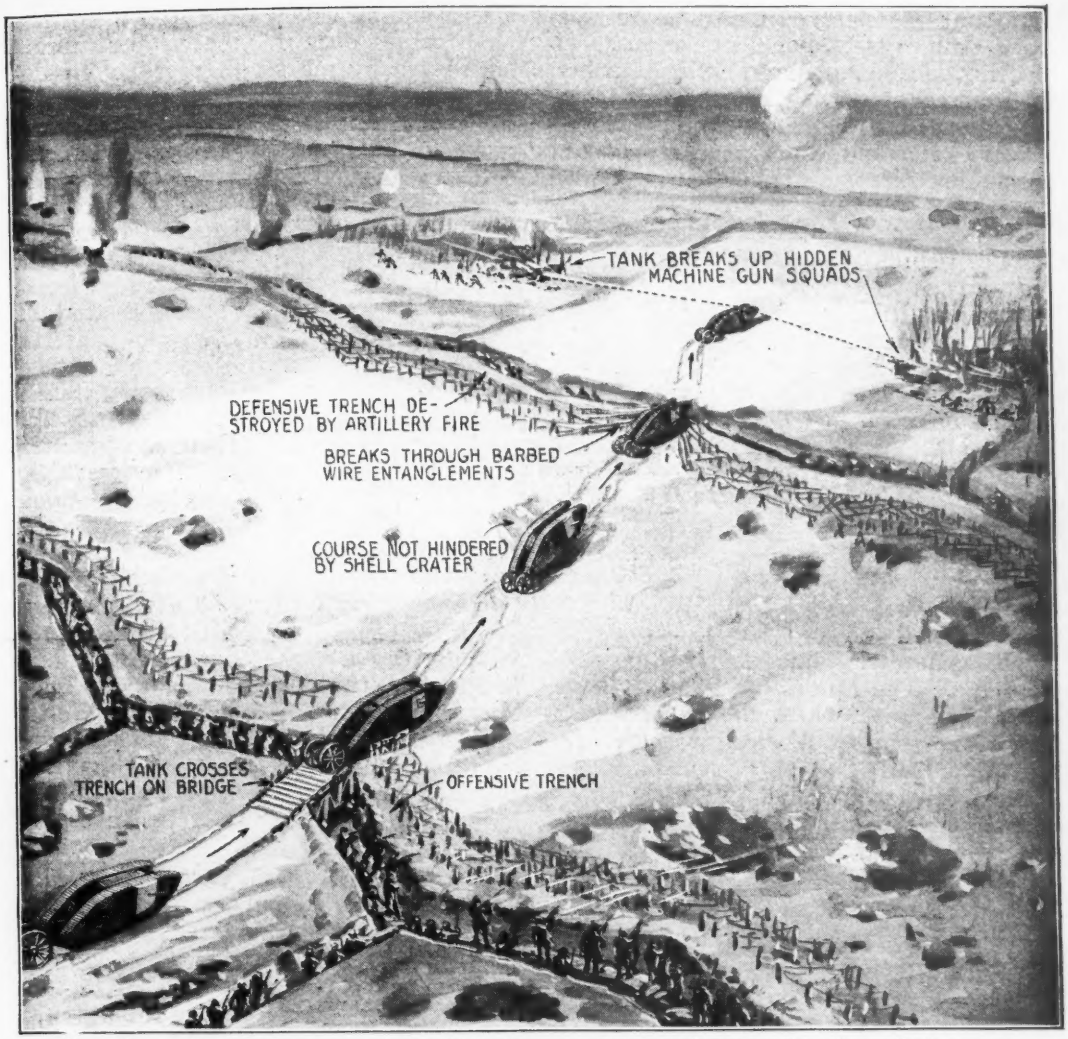
Spitting fire as they came, they crossed No Man's Land amid the smoke and dust of bursting shells. Down and up shell craters they kept steadily on their courses. Nothing mattered. Even trees and boulders were brushed aside by the monsters as so much paper. Still on and on they came to what was left of the German wire entanglements, crushing these as so much putty under their huge frames. And still on and on they came until they reached what remained of the first German line of trenches. There in several places, they sat astride it and themselves complacently swept it in both directions with their guns.

Not even there did the tanks stop, but forged ahead to seek out the hidden German machine-gun squads prepared to mow down the Allied infantry but not to fight steel monsters off whose sides their bullets skipped like pebbles thrown against tin billboards on our city streets. These machine-gun emplacements, which had cost the British thousands of lives in similar attempts to advance without the tanks, were mere child's play for the huge Leviathans of the land.

This done, the infantry advanced, occupied what remained of the German trench and immediately began to dig itself in. Some of the tanks, however, strayed too far beyond the first line of trenches, ran out of gasoline and found themselves stalled between the recently captured trench and the German second line. One such monster, named *Crême de Menthe*, was marooned beyond her objective inside of the German lines but was not captured because the Germans could find no way of getting into her or of penetrating her alligator-like hide of steel. A second tank, *Willie*, as the British Tommies familiarly named it, by a bold dash scattered the Germans and rescued her sister craft by a



Awe-inspiring monsters that they were to the Germans, the tanks were almost as much of a mystery to the British troops


TANK BREAKS UP HIDDEN MACHINE GUN SQUADS
DEFENSIVE TRENCH DESTROYED BY ARTILLERY FIRE
BREAKS THROUGH BARBED WIRE ENTANGLEMENTS
COURSE NOT HINDERED BY SHELL CRATER
TANK CROSSES TRENCH ON BRIDGE
OFFENSIVE TRENCH

How the tanks maneuver on a battlefield. Down and up shell-craters they keep their course, spitting fire on all sides and brushing away any obstacles they may encounter, like so much paper

mere gallon or two of gasoline! The tanks' work thus done, after the capture of the first trench, they ambled back to their shelter behind the Allied lines.

Even the British Were Mystified

Awe-inspiring monsters that they were to the Germans, they were also much of a mystery to their own British troops. The first tanks were built in a walled factory in Lincoln, England, by mechanics who were not allowed to leave their Chinese City for three months, even to see their families. Secretly transported across the Channel, the tanks were assembled behind the Allied lines on the Somme to await call. The stoic Britishers thrilled at the whisper: "The tanks are coming!"

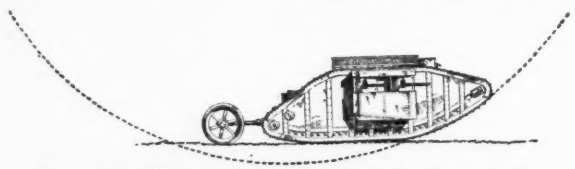
They were an untried military arm. Many thought that they never would return. But they did, and with a most enviable record for annihilating machine gun operators and snipers in a more thorough manner than it had ever been done before. They saved thousands of lives which would have had to be sacrificed if the old method of rushing such nests of death had been adhered to. After the tanks' work had thus been accomplished, the infantry rushed forward to view the destruction.

New as the tanks are, they are but the development of inventions made long ago by two Americans, Holt and Harvey. The former originated the now famous caterpillar device for farming tractors. This apparatus makes it possible for the tanks to

surmount seemingly impassable obstructions, such as trees, boulders, ditches, shell craters, wire entanglements or trenches. Harveyized steel, so named after its inventor, made the tanks impervious to machine gun and rifle fire, shrapnel and everything except a direct shell hit.

How a Tank Is Built

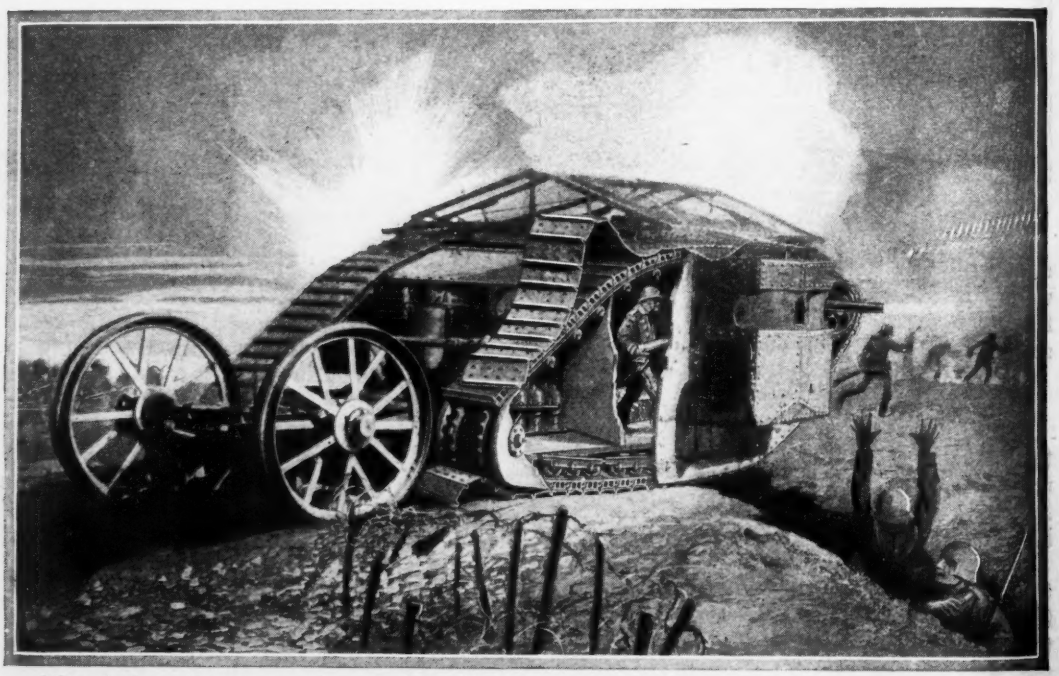
The principal feature of the tank's construction is the caterpillar or track-laying device. This consists of an endless steel belt made up of short sections like shoes, which lie flat on the ground. These support the vehicle wheels which are mounted on trucks somewhat similar to those on railway cars. The insides of the shoes have double rails over which the truck wheels run as shown in the illustration at the top of page 712.



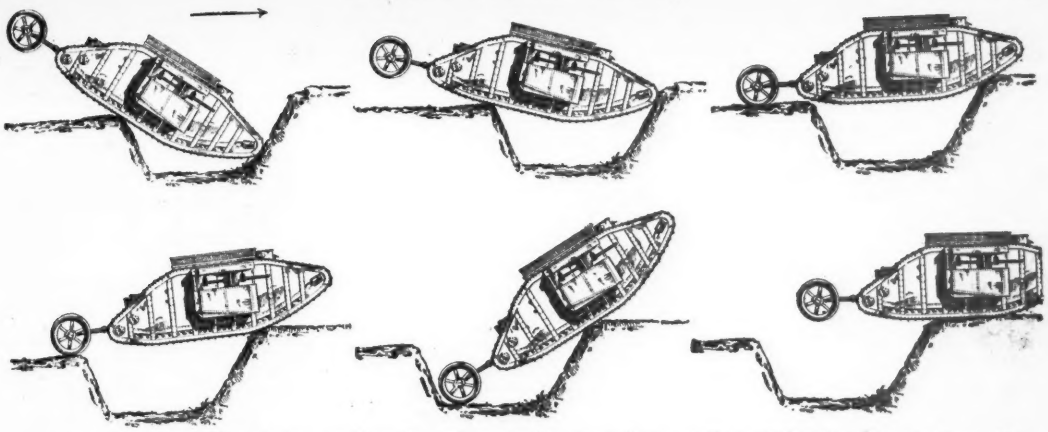
The caterpillar tread is curved up in the arc of a huge circle at the front which gives the vehicle its wonderful tractive powers. This large curvature acts as a huge wheel with a tremendously long leverage equal to the radius of the circle or the spokes of the imaginary wheel of the same diameter. Only that portion of the assumed wheel which would come in contact with the ground acts as the lever, and it is just this portion that is reproduced in the front end of a caterpillar belt

The endless chain made up of the shoes acts as a track, being laid flat under the wheels and picked up again after the wheels have passed over it. The endless chains are driven by means of sprockets on the rear axle of the tank.

The real unusual adaptation of the caterpillar device for which the British designer of the tanks must be given credit is the shape of the belts. This has been carried out in a very different manner from that used on their farm tractor predecessors. Instead of being low and flat, they are strung out over frames thirty to forty feet long and from ten to fifteen feet high, depending upon the size of the tank. These frames are armored with Harveyized steel to provide protection for the tank operators and besides are curved up in the arc of a huge circle at the front to give the vehicle its wonderful tractive powers. This large curvature acts as a huge wheel with a tremendously long leverage equal to the radius of the circle or the spoke of the



All tanks have the common characteristic of being divided into three main compartments between the two side caterpillar frames, the lookout, the ammunition, and the engine rooms. Part of the caterpillar tread of this machine was shot away, thus revealing the construction beneath the outer belt



How the caterpillar crosses a trench. It noses its way down and up, following the contour of the ground. It is steered by the rear wheels or by making one caterpillar go faster than the other

imaginary wheel of the same diameter. Only that portion of the assumed wheel in contact with the ground acts as the lever and it is this portion that is reproduced in the front end of a caterpillar belt.

Why Don't the Tanks Stick in the Mud?

This large area of the belts in contact with the ground, as shown in the accompanying sketches, also brings out the inherent property of the caterpillar which has made it possible for the tanks to traverse soft, muddy ground—the large bearing area of the caterpillar shoes. With the caterpillars thirty inches wide and with about fifteen or twenty feet of length in contact with the earth at any time, the pressure on the ground is said to be less than three pounds to the square inch. This is a great deal less than that exerted by a horse or a two-hundred-pound man. This large supporting area explains why the tanks do not sink down and become mired in places where an ordinary wheeled armored motor car would be hopelessly buried down to the hubs.

The tanks are of various sizes and designs, each later model being an improvement over its predecessors. The first ones had a maximum speed of from six to eight miles an hour. This was too slow, and the Germans soon found a way to destroy them. Before a tank could get back to shelter after a raid, the German observers were able to wireless its position to their artillery which promptly dropped shells on on it. The latest tanks are lighter than their predecessors, have gasoline engines of over five-hundred horsepower and travel at the remarkable speed of eighteen miles an hour!

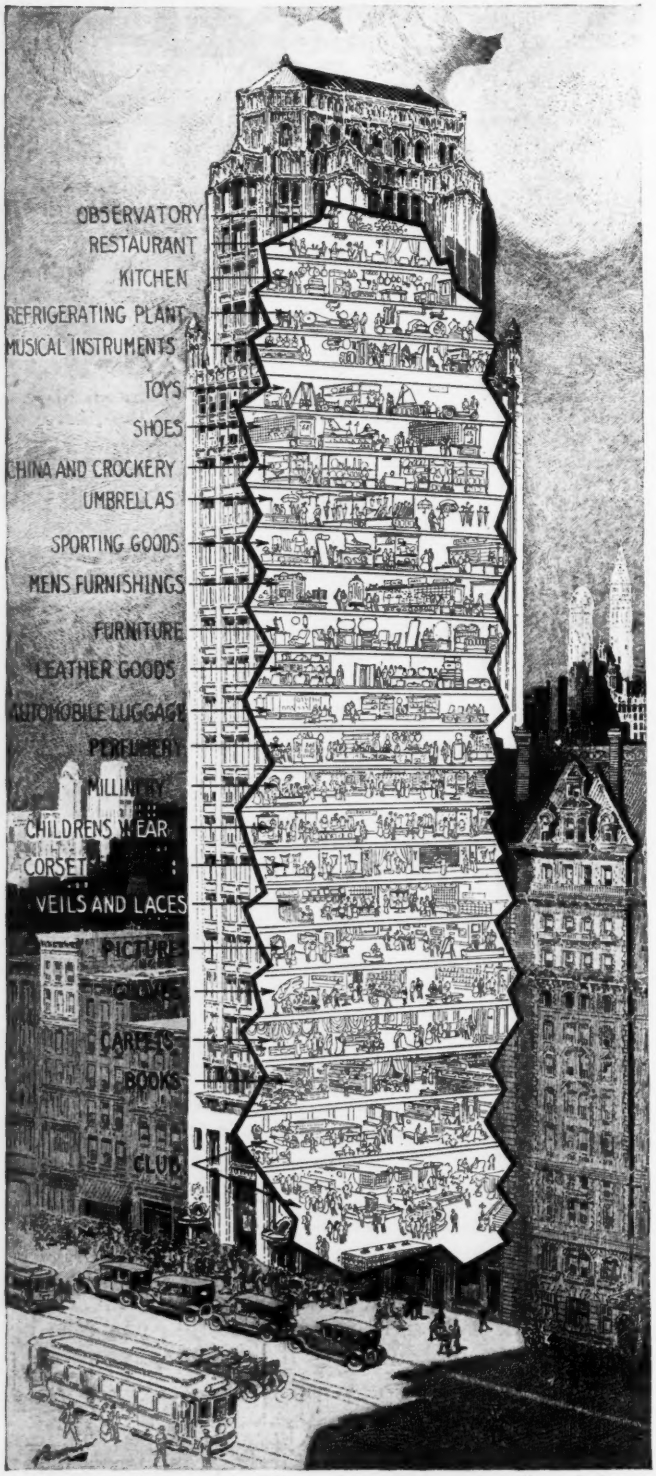
Although varying in size and details, all tanks have the common characteristic of being divided into three main compartments between the two side caterpillar frames. The first is the observation compartment in which the driver and his helper are perched high above the ground to direct the movements of the huge steel beast. In the middle is the ammunition room from which the guns carried in the two side turrets are fed. At the rear is the engine room. From two to four gasoline engines are used, these driving the rear axle and its integral sprockets over which the caterpillars run. The latter run over an idler pulley or sprockets at the extreme front ends and are supported by means of rollers attached to the upper portion of the frame on each side when passing over the top. This movement of the caterpillar belts is exactly analogous to that of the ordinary variety of garden insect with the same name which similarly lays down his own track by humping his back continuously and regardless of the land surface.

How the Tanks Are Guided

The tanks are steered by a pair of small ordinary wheels at the rear. These are supported in a pivot on a frame extended from the rear. They are merely for steering, and support none of the weight of the tank except when bridging wide trenches or dips in the surface. Steering can also be accomplished by making one caterpillar go faster than the other by manipulating clutches on the driving mechanism.

The tanks have been developed entirely by the British Admiralty, the idea of using the large round end of the caterpillar being credited to E. H. Tennyson D' Eyncourt, Director of Naval Construction.

A World's Fair in a Skyscraper



Plan of the great building where the merchandise of the world will be displayed, and where tradesmen, buyers and patrons from out of town will meet to talk shop

THE steel work of a new building which is to house a world's fair now soars high above New York's Great White Way. Two million dollars are being expended upon the structure, and by September 1, war or no war, it will be opened to visitors. The site is Forty-Second Street, just a few steps east of Broadway. The building will be thirty stories high. Twenty-eight of these stories will be cut up into booths 10 x 10 ft. in which will be displayed the widest possible variety of goods. Two other stories will be furnished as club rooms. The basement will be given over to exhibits of heavy machinery.

The idea comes from Irving T. Bush, president of the Bush Terminal Company.

The accompanying drawing is a graphic representation of the structure's architecture, and at the same time indicates, in general, the way the space will be allotted. Jewels and ostrich plumes from Africa, furs from Nome, hats and silks from Paris, rugs from Turkey, paintings from Florence, furniture from Michigan, cotton from Alabama, rubber from South America, plows from Massachusetts, tea and spices from Ceylon, laces, toys, hardware, shoes, books, gloves, traveling bags, umbrellas—everything from diamond dust to traction engines will find a place somewhere in this skyscraper fair building.

The lower floors of the building are described as the "Buyers' Club." They are to be furnished with lounging rooms, a buffet lunch and a bar. The reading room will have among other features, an extensive library of trade catalogs. The exhibitors will have stenographic service at their disposal, ticker tape news and information on almost every subject.

Siamese Twins Among Trees—A Remarkable Double Growth

THE twin elm trees shown in the accompanying photograph have been the delight of the children of Fostoria, Ohio, for almost one hundred years. The connecting limb between the two trees furnishes an ideal support for a swing. The trees are each about one hundred feet high with a diameter of two feet at the bottom. The connecting limb is fifteen inches thick. There is a space of about twelve feet between the trees.

Evidently the grafting, whether done by Nature, accident, or the hand of man, was accomplished when the trees were very young, for it is now impossible to determine to which tree the connecting limb originally belonged.

The trees are twelve feet apart, about one hundred feet high, and are over one hundred years old

How Chemists Have Taken the Poison Out of Common Salt

AS far as the supply of salt goes there is enough available to last us forever. Michigan alone, it is said, claims to be able to supply the whole world for two thousand years with all the salt it needs. But no matter how plentiful salt may be it has the disadvantage of being a poison, for no salt is wholly pure. Thus, if the poison in salt can be eliminated vast additional sources will be available.

Scientists have come to the front and have tackled the problem successfully. By adding a solution of just the right amount of sulphate of soda, the barium or poison in the salt is changed to sulphate, and with it is removed the pink or brownish color due to iron salts. Thus is made available an unlimited supply of salt, which means more raw material for our chemical industries, because the barium-bearing salt is used for salting hides, for glazing pottery and for making ice.

They Aren't Afraid to Go Home in the Dark in Whitewashed London

ALTHOUGH London and the outlying suburbs put out street lights at eight o'clock and appear to say "Good night," and the whole country is swallowed up in darkness, the truth is that the London theaters and night attractions are as popular as ever, Zeppelins or no Zeppelins. When first the lights were turned out, the night-owls of London had a difficult time feeling their way about. Curbs, stone steps, iron lamp-posts and other formidable objects felt different than they looked. But it wasn't long before the population got its night eyes. Lights were put on perambulators and bull's-eye lamps on moving vehicles, but soon these proved unnecessary, so expert did the prowlers become.

The photograph shows some Leicester ladies whitewashing a step for the benefit of the night crowd. Not only are steps whitewashed but projecting cornerstones, lamp posts, and many other objects which have a habit of getting in the way.

© Int. Film Serv.

London Bridge isn't falling down but all London did—until steps and projections were whitewashed

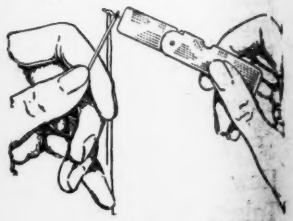
Housekeeping Made Easy

An ice shaver operated by a crank handle which can be used without moving articles in the ice box

A rod which holds a cloth or sponge enables one to wash the outside of windows from the inside

A china hat-pin holder which hangs on the wall. The points are enclosed so that they are not a menace to passersby

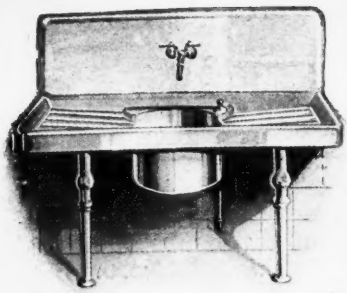
A bookcase converted into a sideboard. It is mounted on castors and is easily moved from kitchen to dining-room and back again as needed



A folding needle threader which may be carried in the pocket or on a chain. It threads the smallest eye as well as larger ones

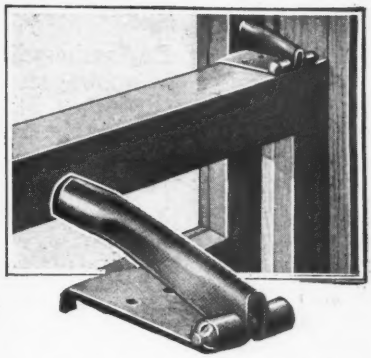
A gas range equipped with an oven heat-regulator. At the right the meal is being removed after it has cooked unattended for hours at an even temperature

Housekeeping Made Easy

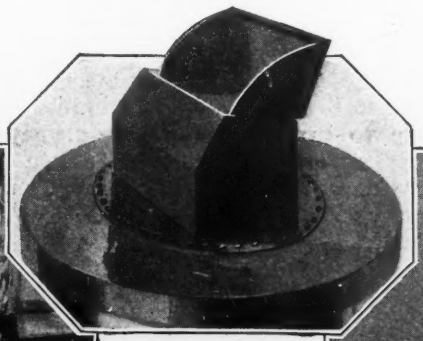


A sink with a built-in dish-pan. A double set of sieves fit into the pan part, which may be lifted out at any time

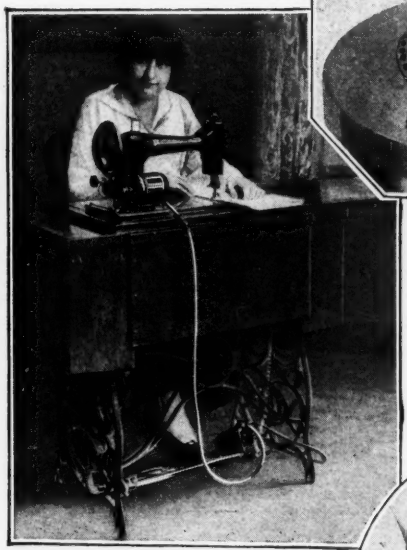
Not a wastepaper basket but an ornamental rack in which kitchen utensils may be kept concealed



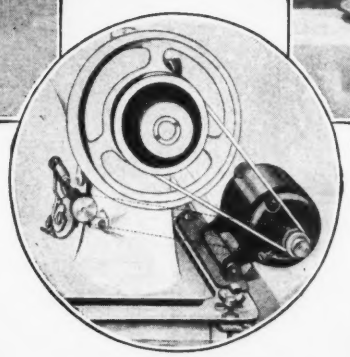
A window lock which is fastened to the top of the lower sash and will prevent the window from rattling



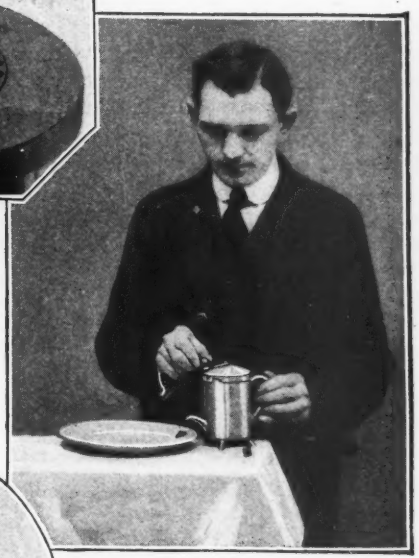
A garbage can with a sanitary cover which prevents insects from entering once it is closed



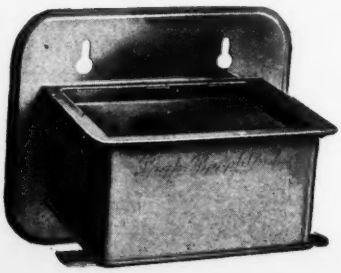
An electric motor for the sewing machine. The foot operates the switch. In the circle at right is shown the motor in place

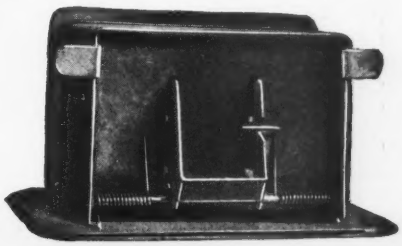


An automatic soap receptacle. A spring pressed panel, as shown at the right, makes it possible for the receptacle to be swung up out of the way



A mustard dispenser. You get the mustard by removing the cap from the spout and by turning the crank in the top of cover





Hiding a Ship in Smoke

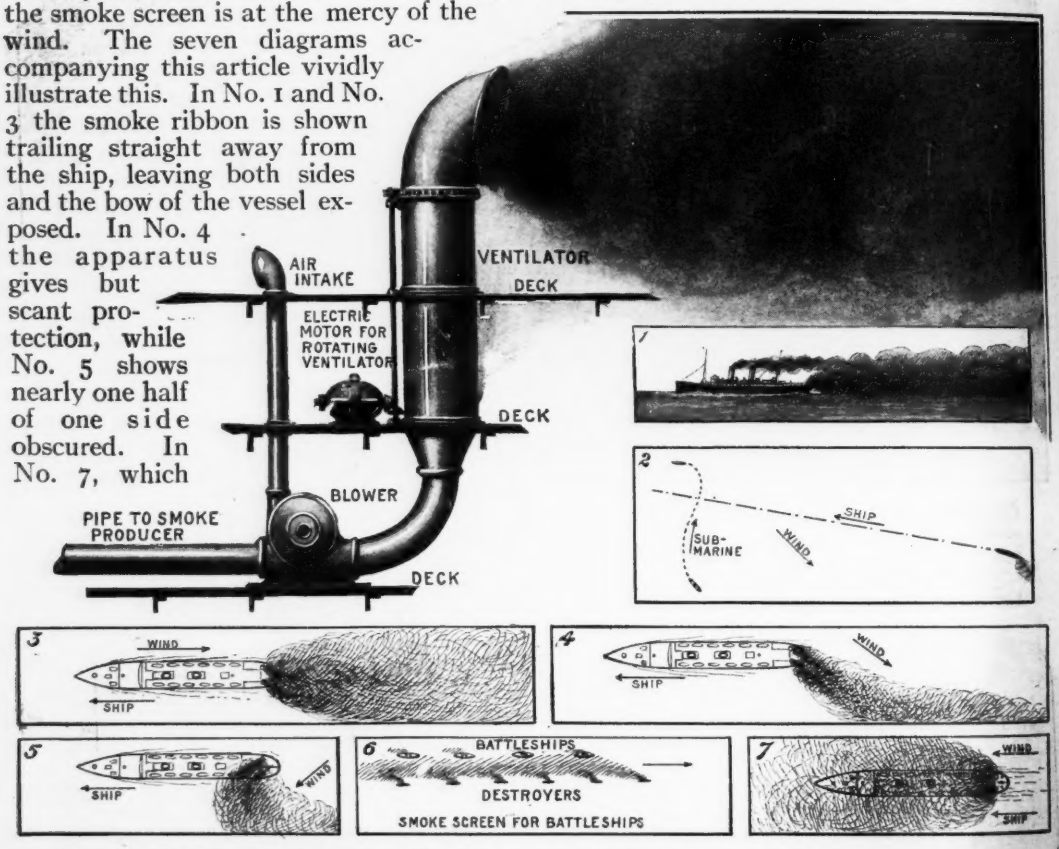
England equips her liners with an apparatus to produce a smoke screen which hides them from submarines

OCEAN liners flying the flag of England are now being fitted with the smoke screen apparatus invented by the British Admiralty as a protection against submarine attack. Several ships equipped with the apparatus have already docked in American ports.

On each side of the afterbridge, where there is always an officer on watch, two funnel-shaped ventilators are placed, from which dense clouds of chemical smoke belch. The ventilators are rotated by a ratchet mechanism which is controlled by electric wires from the bridge of the ship. The smoke, which is thick and heavy, is forced out of the ventilators by a blower in a long ribbon, from two to five miles in length and a hundred feet high.

It is well-nigh impossible to drive or force smoke or dense vapor against the wind by mechanical means. Consequently, the smoke screen is at the mercy of the wind. The seven diagrams accompanying this article vividly illustrate this. In No. 1 and No. 3 the smoke ribbon is shown trailing straight away from the ship, leaving both sides and the bow of the vessel exposed. In No. 4 the apparatus gives but scant protection, while No. 5 shows nearly one half of one side obscured. In No. 7, which shows the wind and ship traveling in the same direction, the screen is very effective, enveloping the ship from bow to stern in a thick pall of smoke. The method of smoke-screening a line of battleships by torpedo boat destroyers is shown in No. 6. Both the battleships and the destroyers, traveling at approximately thirty knots, maneuver for a favorable wind direction before the destroyers belch their smoke. With the smoke screen or shield to cover them the fleet conceals its movements. Ordinarily the number of destroyers varies with the number of battleships, but not necessarily so.

Although the captain on the bridge is able to rotate the ventilators, he can not throw a screen of smoke around his vessel if the wind is against him. This is brought out very clearly by diagram No. 2, which shows how a submarine could choose its own position and wait for its victim.



Two ventilators rotated by a ratchet device are placed one on each side of the afterbridge. The smoke is either generated in the ship's fire box by burning oil or naphtha, or in a smudge pot

That Wonderful Watch in Your Pocket

It breathes, and its heart beats like that of a human being

By John J. Bowman

OPEN the back of your watch-case and look at the "works"—more correctly, at the *movement.* The mechanism seems complicated. And so it is. There are in the average watch movement about one hundred and fifty separate parts. Many of these, to be sure, do not take an active part in the running of the watch, but simply constitute a framework, providing bearings for the moving parts.

The mainspring in its "barrel"

Winding the watch wraps the mainspring around the central hub in the barrel. The effort of the spring is now to unwind itself. This effort of the mainspring causes the rotation of the barrel

Look into the watch when it is going, and you will see one large wheel-like part which is in very rapid motion, "beating" in alternate directions. This is the *balance.* It is the balance that does the actual time-keeping. The rest of the machinery is required (1) to keep the balance in motion, and (2) to make the rate of motion visible as "time-keeping" on the dial of the watch.

The balance is the governor; its function is comparable with that of the pendulum in a clock.

One of the illustrations shows a watch with part of the framework removed. The balance may be seen at the top of the picture. We will examine its construction in detail later on, and we shall see some wonders it performs in its ceaseless round of duty. The gear wheels and pinions shown carry power to move the balance, the source of power of course being the mainspring.

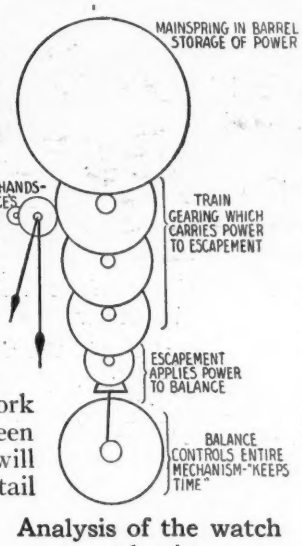
The gear-teeth on the barrel drive a pinion fastened to the shaft of the large gear-wheel in the center of the watch. This center wheel in turn drives the pinion fastened to the next wheel, and so on. Thus the power is carried to the escapement.

What Makes a Watch "Tick"?

The purpose of the escapement is to apply a little power to the balance at each beat of the latter, to keep it in motion. It is the action of the escapement which is heard as the "ticking" of the watch. Of course the power, as it comes down from one wheel to another, turns each wheel constantly in one direction; but the escapement is so made as to apply the power to the balance first in one direction, and then in the opposite direction, since the balance must make its beats in alternate directions. In the past three centuries, men of highest scientific and mechanical genius have applied themselves to the problem of perfecting the escapement, which is the most complicated part of the watch.

The delicate balance wheel

The balance rim of brass-steel, is cut into two portions, for expansion and contraction, to suit the temperature. Each end is free to move inward or outward, toward or from center


MAINSPRING IN BARREL STORAGE OF POWER
DIAL-TRAIN & HANDS-MAKES BALANCE'S TIMEKEEPING VISIBLE
TRAIN GEARING WHICH CARRIES POWER TO ESCAPEMENT
ESCAPEMENT APPLIES POWER TO BALANCE
BALANCE CONTROLS ENTIRE MECHANISM-"KEEPS TIME"

Analysis of the watch mechanism

A stream of power flows from the mainspring barrel down through the train and escapement to be consumed in keeping the works in motion. The parts (above) are arranged in a straight line. In a watch, however, they are in a curved line to park them into the smallest space possible

A watch is simply a machine for "making motion"—and the supreme wonder of a good watch is its uniform rate of motion. Bearing all of this in mind, it is easy to understand what was mentioned in the beginning of this article, that the balance, which controls the rate of motion of the entire watch mechanism, is essentially the time-keeping part of the watch. The

rest of the watch simply "serves" the balance by keeping it going, and by making its rate of going conveniently visible.

You can see the hairspring in your watch vibrating just above the balance wheel. The hairspring is properly considered to be a part of the balance. Its beautiful action, as the coils expand and contract with the alternate swings of the balance, has been termed, and very aptly likened to, "breathing."

This hairspring is a vitally important part of the modern watch balance, and provides the wonderful control known as isochronism (equal timing), which overcomes the effects of variations of the mainspring's power. For the power applied to the balance varies. It is greater just after winding the watch and gradually becomes less as the mainspring runs down. As the power decreases, the balance naturally takes shorter swings. The shorter swings, one would assume, would occupy less time. Hence the watch would run faster and faster towards the end of its day's run. This would certainly be the case were it not for the isochronal control which the hairspring exerts on the rate of speed at which the balance moves during each swing.

Making a Watch Run Uniformly

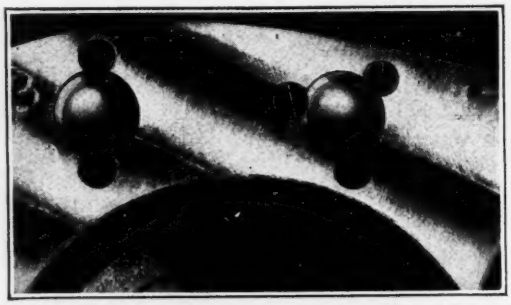
Let us assume, in order to illustrate the principle, that the balance makes one complete turn at each "journey" when the watch is wound up, but as it runs down, the lessening power produces shorter and shorter journeys of the balance until they are reduced, let us say, to only half a turn. These half-turn journeys would each require only half the time which was occupied in making full turns, and the watch would go twice as fast as when the balance was making journeys of one full turn each.

But the isochronal control exerted by the hairspring on the balance steps in here, and interferes with natural conditions to such extent that the balance will make the short journey *at a proportionately slower speed*—one-half as fast—so that the short journey will require just as much time to make as the long journey.

We have seen what a great service the hairspring renders the balance in controlling its motion. Now it will be shown that the balance is not an ungrateful creature, and that it helps the hairspring quite as much as the hairspring helps it! In fact, good time-keeping is possible only because balance and hairspring cooperate in correcting in each other certain mechanical effects which need to be counteracted.

Why Your Watch Keeps Good Time in Winter as Well as in Summer

The hairspring's shortcoming is that the condition of its metal changes with varying temperatures; in cold weather it becomes stiffer, and in warm weather more pliant. This would naturally cause the watch to run fast in cold, and slow in warm weather. And that is how watches did run before the invention of the modern *compensating* balance. This compensating balance is cleverly devised to alter its diameter at every change of temperature. On a cold day the balance automatically grows larger and runs slower, just enough to compensate for the quickening of the hairspring's action. If the watch is then carried into a warm room, the balance promptly makes itself smaller and runs faster by just so much as the warmed hairspring would have made it run slower.

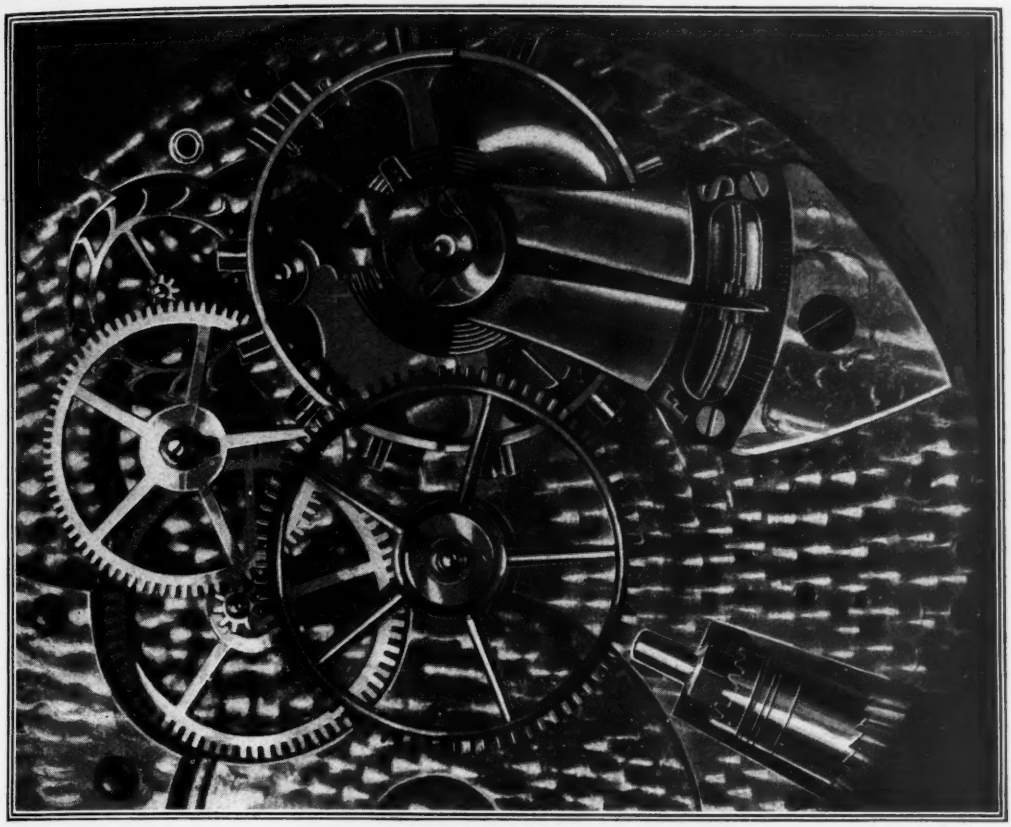


The jewels of the watch are held in place by screws

Some watches have all the pivot bearings jeweled; some just a part of them. There are watches of obscure origin with jewels in them inferior to plain drilled metal bearings. Of such watches it may be said that the more jewels the poorer the watch. It is of prime importance to have competent advice when selecting a watch. The cost of the movement is a measure of its efficiency

The balance rim is made of two metals (brass and steel) fused together. When heated or cooled, the brass (on the outside of the rim) expands or contracts faster than the steel portion forming the inside of the rim. When heated, the brass, in trying to lengthen out beyond the steel, bends the arms inward, and when cooled, the brass, in trying to contract shorter than the steel, bends the arms outward.

Adjustment of a watch to heat and cold consists in altering the positions and weights of the screws on the balance rim until the action of the balance corresponds



The framework removed to reveal the train, escapement and hairspring of a watch

The hairspring is never-ceasing in its vigilance. If you move suddenly you may shorten the swing of the balance; but the hairspring instantly checkmates this by reducing the speed in exact proportion to the reduction in the extent of motion. Again, the balance may have its journey lengthened above the average by an increase of power, or by an external motion (as when you happen to give the watch a "twisting" motion). In this case, the hairspring instantly increases the speed of the balance in direct proportion to the increase of the extent in motion. Now, you understand how the hairspring helps to make good time-keeping possible, by making the balance "space off" portions of time which are equal under all conditions. In cheap watches the hairspring is not "adjusted to isochronism." In better grades the isochronal (uniform timing) adjustment is secured by forming the hairspring's outer coil into a certain shape, found for each watch individually by experiment and trial. The practical application of isochronal adjustment requires high intelligence and skill on the part of the watchmaker. Yet no watch keeps perfect time constantly with the changes in the hairspring at different temperatures. Cheap watches are not adjusted to temperatures.

Fine watches are put through a series of adjustments to positions, in addition to those for isochronism and temperatures. In position-adjusting, the mechanism of the watch is altered where necessary so that the frictions affecting the moving parts, hence the timekeeping, are alike whether the watch is run lying down or hanging, or in any other position.

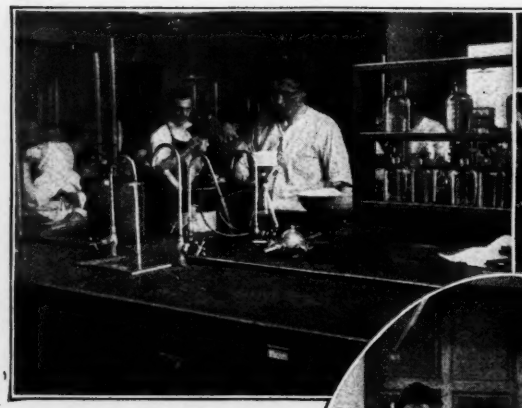
Why Has a Good Watch Jewels?

What are the advantages of jewels in a watch? In the early days of watchmaking, the bearings for the pivots of the moving parts were simply holes drilled in the metal of the framework. This is still the case in cheap watches. But good modern watches have the bearings made by drilling holes in hard ruby or sapphire disks. These disks are mounted in the framework, and in their highly polished holes the pivots turn with much less friction than in metal bearings.

A first-class watch can be expected to keep time to within a half minute a week, while in use by an active person. Worn by a sedate, careful person, a good watch may run even better. It then remains for the owner to have the good timekeeping quality of his watch maintained by having it cleaned and oiled by a reliable watchmaker, at least every two years.

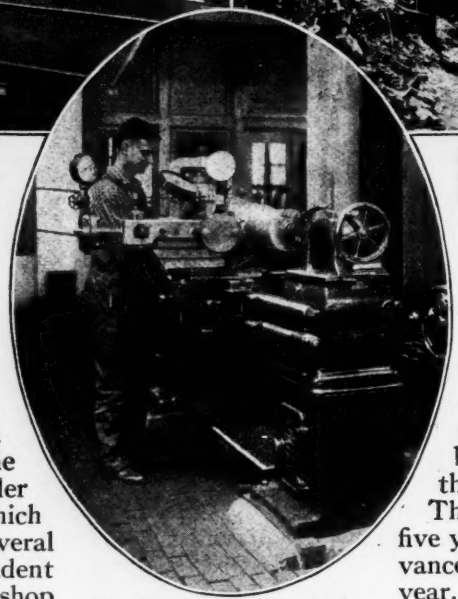
A College-Factory Engineering Course

A plan for combining college preparation with factory experience



The student takes his place regularly beside the other workmen in the factory

No Latin and Greek, no desks, but they are going to college just the same



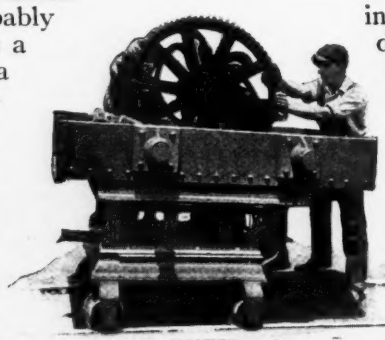
He alternates two weeks in the shop with two in school

BY combining their regular University studies with shopwork in the factories, shops and engineering plants of the city, the Cincinnati University has worked out a practical scheme for the training of engineers. Under this co-operative plan, which has been in force for several years, the engineering student spends half of his time in shop and half in school. In the factory he takes his place beside the regular machinist or other workman, and becomes an actual producer. If he is a student of mechanical engineering he will probably be put into a foundry as a helper or in charge of a simple machine tool. Immediately he becomes a regular employee, subject to all the shop rules and regulations, being paid for his services the same as any other man doing the same kind of work.

There are two students for each job. One man goes to the University for two weeks, while the other man, called an "alternate," works at his bench in the shop. Then at the end of each two-weeks period, the alternates switch about; the student becomes a workman, and the workman a student.

The course is completed in five years. As the student advances in school from year to year, his shopwork likewise progresses according to a prearranged plan. For instance, a first year student who begins in a foundry, machine shop or power plant, will, during his fifth year, be engaged in designing, estimating, production, or other work of a higher grade. A representative of the University, usually a head professor, looks after the interests of the students in the shop, and sees to it that they get the proper experience under proper conditions.

The college work includes the usual studies that go to make up a regular four-year theoretical course.



As the school work advances in grade the shop-work also progresses according to a prearranged plan of instruction

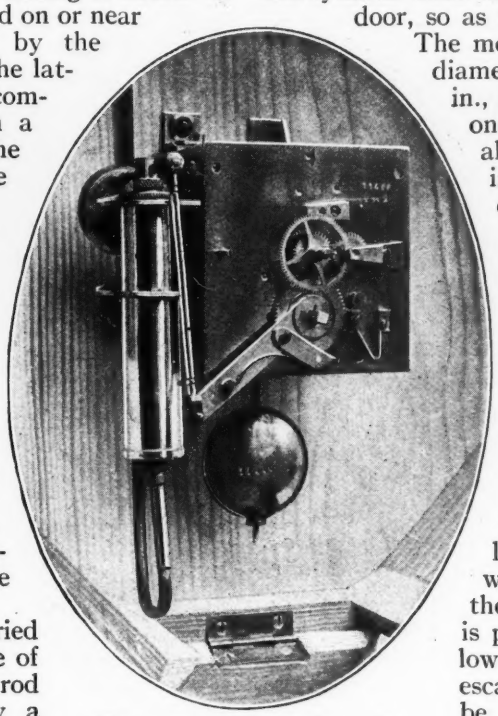
Open the Door and Wind Up the Clock

The swinging door compresses air which operates a winding mechanism

A FRENCH inventor, Gustave Delannoy, has devised an original scheme for winding clocks by air-pressure obtained by opening and closing of doors. A small air pump arranged on or near the door is operated by the opening or closing of the latter, and the air thus compressed is led through a thin metal tube to the clock or clocks to be wound.

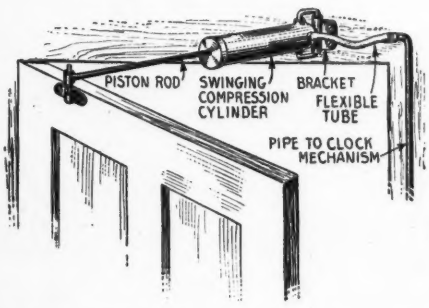
The air cylinder is pivotally supported by a bracket screwed to the door frame. The free end of the piston rod is engaged by a pin on the door. Air drawn into the cylinder during the opening movement of the door will be compressed during the closing movement and expelled through a flexible tube connection.

The air pump is carried on the wall at the side of the door. The piston rod is held stationary by a bracket, while the cylinder is movable lengthwise of the piston rod, by means of a cord passing over a pulley and attached to the door. By opening the door, the air in the cylinder is compressed and expelled through the hollow piston rod into the tube. A cord attached to the left end of the cylinder and winding on a roller containing a coiled spring, will pull the cylinder back during the closing of the door, so as to keep the cord taut.



The compressed air from the cylinder on the door raises the piston which winds the clock

The metal tube (of an inner diameter of from 3/32 to ¼ in., and of a length of over one hundred yards) leads along the walls, conforming with their bends and corners, to an air cylinder arranged preferably in the casing of the clock to be wound. The compressed air in the tube will raise the piston in this cylinder. This movement will wind the clock by means of levers and the spring-pressed pawl on the levers which engages with the ratchet wheel of the clock spring. A valve is provided which will allow any excess pressure to escape and which will also be opened in case the weight driving the clock has reached its uppermost position. Another weight returns the piston in the cylinder to its normal position. Instead of the cylinder, bellows may, of course, be used which will be lifted by the action of the compressed air in the manner described and will perform the same operations. A weight may also be employed to pull the cylinder back, instead of the roller and cord.



A small air pump is operated by the opening of the door and the compressed air is led to the clock through a flexible tube connection

Any Type of Fighting Craft Costs a Fortune to Build

A MODERN giant battle cruiser will cost approximately $20,000,000; a super-dreadnought can be built for $18,000,000; a scout cruiser for $6,000,000; a destroyer for $1,300,000; while ordinary submarines cost $600,000 each for the smaller type, and from $1,000,000 to $1,200,000 each for the larger boats.

A Gentle but Firm Restrainer for the Insane and Delirious

A RESTRAINER for the insane or delirious, which has none of the bad effects of the straitjacket or of tying and holding, is shown in the photograph. It allows the patient the free use of his arms and legs, but at the same time checks any attempt at violence and effectually prevents him from getting out of bed.

The fastenings are concealed out of his reach and he cannot work them loose.

The fastenings are out of the patient's reach and he cannot work them loose. The night-robe conceals the restrainer

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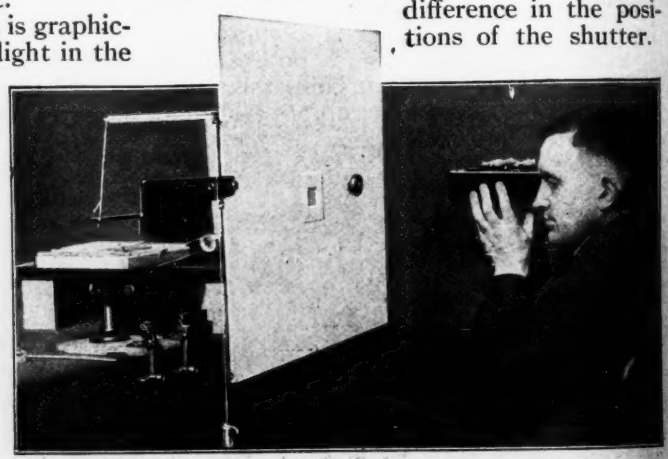
Determining the Best Lighting Conditions for the Eye

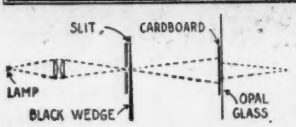
IN spite of its wonderful adaptability, the eye can be impaired by a poor lighting system. Hence it is that the finding of the best lighting conditions is so important a problem. An apparatus which has done much towards the solving of this problem is shown in the accompanying illustrations. It consists in reality of two instruments. One furnishes a variable source of light while the other furnishes a means for viewing and for measuring this light.

The first of these instruments is graphically shown in the diagram. A light in the rear of the instrument throws its rays upon an opal glass window after having been sent by a pair of lenses through a "wedge" of blackened glass. By varying the opening in this wedge, the amount of light emitted at the window is made to vary accordingly.

The second instrument is a long box-like arrangement. Through this, an observer views the window with one eye. He notes the sensation produced by this light upon his eyes, and at the same time he measures its intensity. This measurement is accomplished by means of a small "standard" electric light which is placed in the instrument. The light from this lamp is thrown on a mirror placed inside the instrument and adjacent to the front slit. Thus, the light from it and from the window can be viewed at the same time. The light from the small lamp is varied by a shutter which is operated from the outside of the instrument. Because of previous calibrations, the position in which the shutter is moved will show on a scale the exact intensity of the light let through to the mirror. Hence, by adjusting this shutter until the light from it and from the opal window are the same, the exact intensity of the latter is directly obtained from the calibrations of the shutter scale. In this way the effects of different intensities of light upon the eyes of different individuals are determined.

Of equal importance to the study of good illumination is the comparison of effects of rapidly varying intensities upon the eyes. Obviously, this apparatus assists here, also. The black wedge varies the intensity and the variation is ascertained by reading the difference in the positions of the shutter.





Arrangement of apparatus for subjecting the eye to varying brightnesses. At left is a diagram showing the direction of the rays from the lamp

Saving a Man from a Burning Building with His Own Coat

VARIOUS devices have been invented and placed on the market to lighten the fireman's burden; but Nicholas Carson has demonstrated to the fire department of Cincinnati that it is possible to carry a person down a ladder or a fire-escape without any kind of special apparatus.

Carson's method of rescue presupposes that the person to be rescued is wearing his ordinary clothing. The coat is pulled halfway down over the shoulders and its end is brought up and wrapped around the collar, the wrapping being done from the inside outward and the arms being left in the sleeves. This makes an improvised rope of the coat and holds the arms securely at the elbows.

To carry the victim, the rescuer slips his own head under the coat-rope so that he and the victim are back to back, with the victim suspended by his arms from the fireman's shoulders.

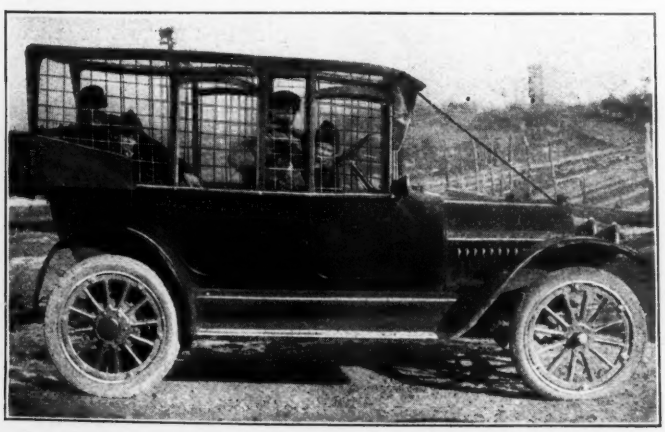
An improvised rope is quickly made of the person's coat. This is slipped over the rescuer's head

A Wire-Mesh Top for the Automobile. It Saves Hats and Veils

TAKING account of stock at the end of an exhilarating automobile trip has doubtless revealed that a comparatively new hat or two, and perhaps some perfectly good and more or less expensive veils have passed on to other owners.

To prevent such losses without curtailing any of the pleasures of automobiling, B. F. Cone, of Ashland, Neb., has invented a safety guard of wire mesh which will fit over the body of any make of automobile. It will also serve as a protection from brushing tree-branches and from other menaces to personal safety and comfort when traveling through less frequented places. If a bad spill should occur, it will prevent the occupants from being thrown out of the car.

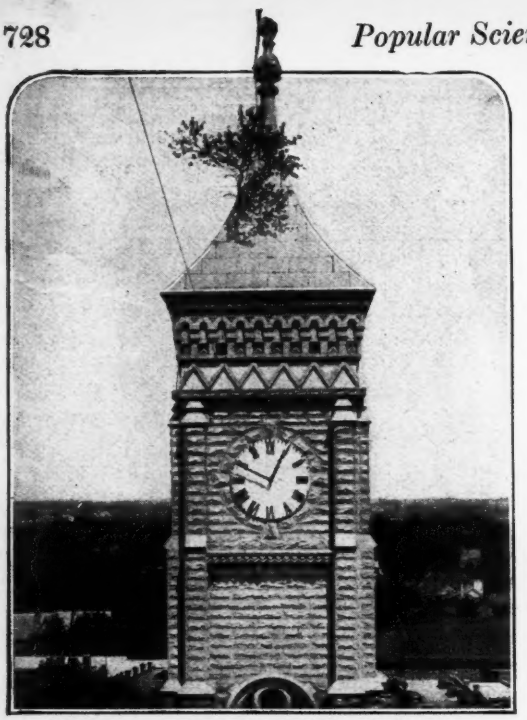
The uprights of the frame are secured to the bottom of the sides of the car, passing up through the sides to the top and meeting there a reinforcing bar which extends from front to rear. These uprights are of steel and are heavily padded on the inside of the car so that if the occupants should be thrown against them no harm would be done.



The passengers of the automobile are not being taken to jail. The netting protects their hats from the wind

Another Outcome of the War—The American Evaporated Vegetable

THE hunger of Europe has started a new industry in America. A year ago the Allies could not supply enough vegetables for their men in the trenches. Awake to this fact, American growers experimented on drying treatments which would insure their vegetables reaching the trenches in edible condition. They succeeded, and the result is the evaporated vegetable industry. Western New York is supplying most of the evaporated food, and already thousands of tons have been shipped to the armies in the war zone.



At one time there were no less than seven of these tiny trees growing on this tower

A Miniature Grove that Grew on a Court House Tower

IN the summer of 1870 a citizen of Greensburg, Indiana, whose name posterity has not preserved, was examining the Court House tower with a spyglass, when he noticed a small sprig springing from the third crevice above the water sheet on the southeast corner of the tower, one hundred and ten feet above the ground. He watched that sprig grow to be a tree. Now the tree is one of the local wonders.

During the late seventies, other trees sprang up on the tower. At one time there were no less than seven. The entire grove was allowed to flourish until the Court House was remodeled in 1888. It was then deemed necessary to remove some of the trees, inasmuch as the largest was increasing in girth to such an extent that apprehension was felt for the roof. Three other small trees were removed at the same time. Since then all the others have died except the one decorating the northwest corner.

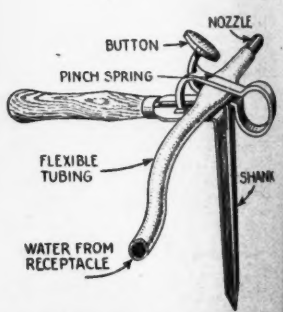
The solitary survivor is exceptionally hale and hearty season after season. It never seems to be affected by the summer droughts, but remains green even when the trees in the Court House yard are yellow for lack of rain.

How were the trees planted? Some think that birds carried seeds that lodged in the crevices between the stones; others believe the seed or sprout to have been in the mortar used in laying the rock.

A Combined Waterpot and Hoe for the Gardener

A SIMPLE transplanting device which is nothing more than a borer and a watering tube combined in one instrument, makes it possible for the gardener to wet the ground while he is digging a hole in it and to water a plant immediately after he has prepared a bed for it.

A can containing the water is strapped to the gardener's back. Attached to an outlet in the bottom of the can is a tube which carries the water to a nipple fastened to the borer. The tube is ordinarily kept closed by means of a compressor. When the gardener wishes to water the plant or soak the ground, he presses down a button which releases the compressor and allows the water to flow out of the nipple. In its normal position the borer and the watering tube are at right angles to each other, so that it is necessary only to turn the wrist to use either one. The inventor is Herman C. Moen, of Madison, Wisconsin. With this device the farmer can set out his plants and water them before they wilt.



With the new device the gardener can dig a hole and water the soil at the same time, simply by turning the wrist

What's a Dreadnought? And the Purpose of a Dreadnought?

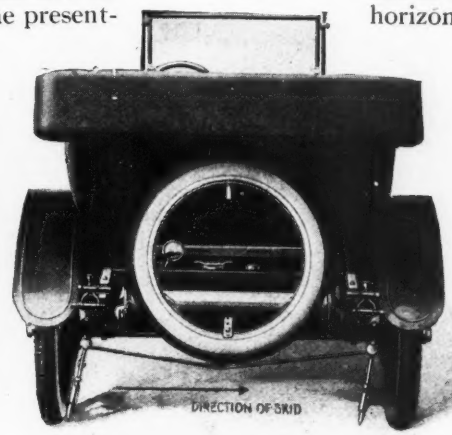
IN these days of stirring events and nation-wide discussions of preparedness, naval terms are frequently confused in ordinary conversation.

It is generally known that the displacement of battleships—that is, their actual weight in tons—has increased by leaps and bounds from the original five or six thousand tons to the present-day battleships of upwards of thirty thousand tons. The term "dreadnought," however, did not come into use until 1906, when the British Admiralty evolved what is known as the first all big gun ship. Prior to that time nearly all battleships were armed with four large guns of ten, twelve and sometimes thirteen-inch caliber, and from twelve to fourteen smaller guns, varying in diameter from six to nine inches. The British Admiralty adopted the bold plan of building a vessel armed with a main battery of ten 12-inch guns and no guns of smaller caliber. This vessel was named the "Dreadnought," and hence became the forebear of the type of ships armed with big guns exclusively.

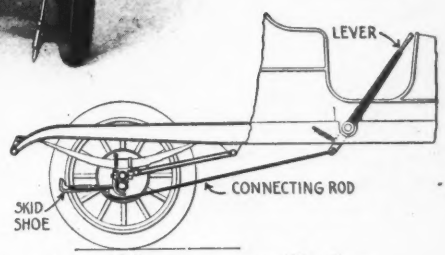
The departure was copied by all the great naval powers, and the race in size and number of guns has gone on uninterruptedly, so that this country now is building battleships like the "Mississippi" of 32,000 tons displacement and armed with twelve 14-inch guns. A new term has been found necessary in the popular mind to describe these leviathans of over 25,000 tons; they are called "super-dreadnoughts." Battleships built just before the time of the "dreadnought," but which did not carry all big guns in their main batteries, are termed "pre-dreadnoughts." "Battle cruisers" while not so heavily armored as dreadnoughts possess much greater speed.

A Non-Skid Automobile Device Without Chains

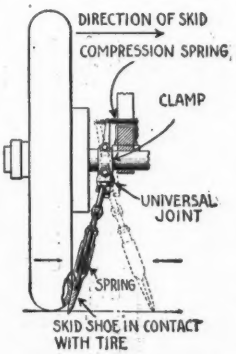
A NEW non-skid device consists of two prong-like bars attached to the rear axle of the automobile and operated by a hand lever at the driver's seat. The prongs are mounted in ball-and-socket joints in clamps around the axle between the spring fastenings and the brake drums. When out of action the prongs are held horizontally and entirely out of contact with the ground. Should the vehicle begin to skid, they may be revolved and thus brought down into contact with the ground and against the tires. Each prong is made of two parts. The flat but narrow bottom shoe-like portion telescopes into the upper end and has a certain upward movement when a spring in the telescoping section is compressed.



The non-skid device is composed of two bars attached to the rear axle and controlled by a spring



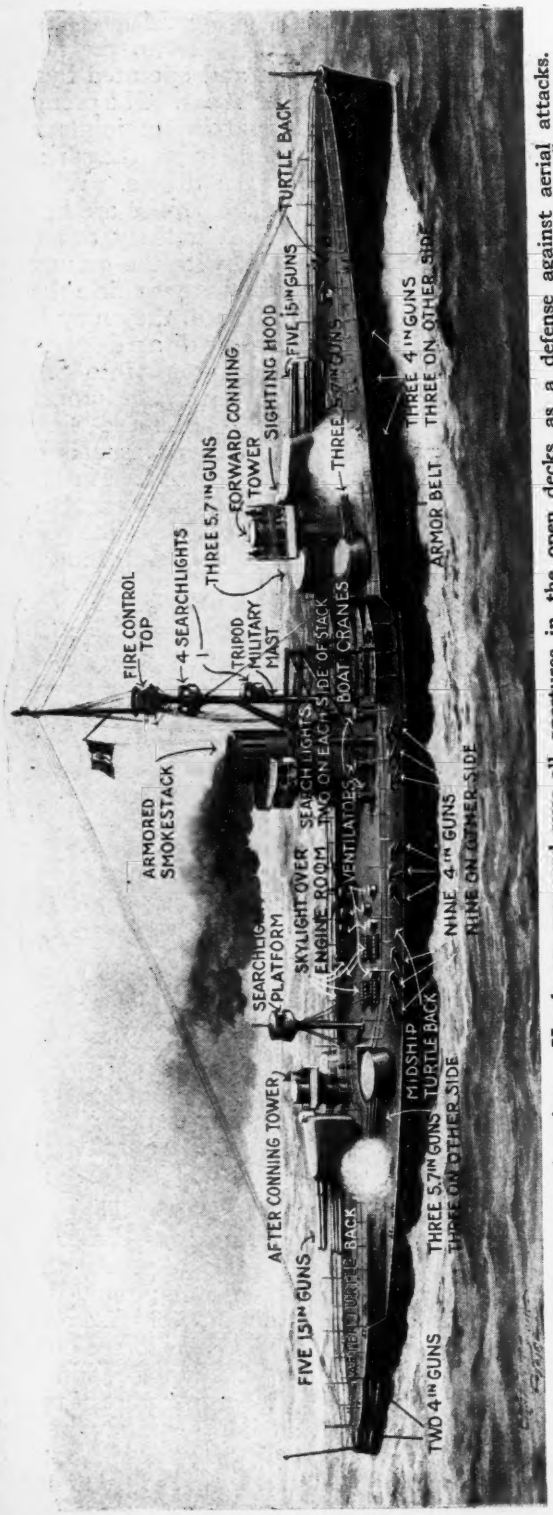
The two prong-like bars are operated by a hand lever at the driver's seat



How the device works when the vehicle begins to skid

The prongs are lowered when the vehicle begins to skid. The one on the side toward which the vehicle is skidding, swings inwardly to an inoperative position due to the ball-and-socket joint and the yielding shoe. That on the other side, however, comes in contact with the tire. As the shoe scrapes over the ground the tire forms a buffer until the vehicle's side motion is stopped. The shoe is forced outwardly against the tire by a spring-retained lever pressing against the upper part of the prong. The yielding shoe serves to protect the prong from injury should it happen to strike on a street car rail. Otherwise the skidding momentum might be sufficient to break it.

The Battle Cruiser of the Future



General view of the proposed cruiser. Hoods are arranged over all apertures in the open decks as a defense against aerial attacks. The principal armament comprises ten fifteen-inch guns, divided into two groups of five guns each, at the bow and stern of the ship

COLONEL E. FERRETTI, a well known naval architect of Naples, has utilized in the construction of a new type of battle cruiser all the lessons taught so far by the present war. The new type of battle cruiser is of thirty-two thousand tons displacement, the same as the dreadnought Pennsylvania, the new flagship of the Atlantic Fleet.

The fundamental principles accepted by Colonel Ferretti as necessary in the construction of a vessel superior in a fighting sense to any other now in use are: Suppression of everything not absolutely required for purposes of naval warfare or for life on shipboard; reduction of all auxiliary services; reduction to the minimum of the above-water body of the ship; adequate protection of the vital parts in the largest sense of the word; definite separation between compartments; maximum arc of gun fire.

The hull of the ship is constructed of the Isherwood type of longitudinal framing. The sides of the ship are divergent above water, even in the central part of the ship. There is, of course, a double bottom. The interior of the ship is divided by three pairs of bulkheads into four zones, the innermost being securely protected against under-water attack.

For a space of three hundred and one feet, the space covered by the heavy and intermediate guns, the height of the ship above water is only a little over nine feet. Superstructures are provided forward and aft, twenty-two and nineteen feet above load line. Every other superstructure is suppressed, except the smokestack, the military mast, armored conning towers and fire control stations.

The principal armament comprises ten fifteen-inch guns, divided into two groups of five each, at the bow and stern of the ship. The five guns of each group are placed in one turret with two planes of fire, three guns in the lower plane and two in the upper plane.

The secondary armament consists of twelve seven-and-five-tenths-inch guns, twenty-eight four-inch guns, and eight torpedo tubes. The protection of the ship against gun fire is assured by the reduced target area, the distribution of armor over the exposed side, and the inclination of the above-water side.

Sharing Your Flowers with Distant Friends

SINCE the parcel post system has been instituted it has become possible for suburbanites and dwellers in rural localities to share a number of their good things with their city friends or others at a distance. Even flowers may be sent as far as the fourth zone without parting with their fragrance or freshness on the journey, provided they are correctly packed. But not all flowers are good travelers. There is little use in trying to share the beauty of a bed of poppies, cannas, moonflowers or others of like texture, with distant friends. Roses, too, are rather delicate to send on long trips. But if they are picked when only partially blown and are kept in cool water until the petals and stems are full, they will not wilt badly and will revive readily at the end of the journey.

Flowers intended for sending away should be cut early in the morning while still wet with dew and allowed to stand in cool water for the remainder of the day so that they will absorb plenty of moisture. Choose a corrugated box, if possible. The long, slender variety of pasteboard box in which flowers are usually sent from the florists will not do for long trips by parcel post. They are liable to bend in the middle or to be crushed. Line the box first with ordinary paper and then with wax paper. If you wish to finish it off very nicely, a layer or two of white tissue paper may come next. Lay the flowers carefully in the box, long stemmed ones first, and fold the coverings in neatly.

Blasting Holes with Dynamite—It's Cheaper and Quicker than Digging

DIGGING pole holes with dynamite is a comparatively new practice, which is fast supplanting the slow and costly hand method. It has two main advantages as compared with hand digging, in that it requires the services of fewer men for any given number of holes and leaves the holes clean.

Instead of long-handled shovels a long punch bar and a sledge or a soil auger are used. After the position of the hole has been determined, a hollow from six to ten inches deep is dug with an ordinary shovel. This hollow has the same diameter as the hole required, and its sides are trimmed straight and clean to relieve the pressure of the explosion and prevent shattering of the surface soil. This forms a kind of crater around a smaller hole.

The explosion of sticks of dynamite blasts the hole clean in a fraction of a second

The dynamite sticks are tied to a pole and are fired off when buried in the ground

The next operation is to bore a small hole in the center of the hollow by means of the auger. Then several pieces of stick dynamite are tied to a small lath at intervals varying from six to twenty-four inches, as shown in the oval above, and the lath is inserted in the hole.

A blasting cap is attached to the topmost piece of dynamite and the whole charge fired from a short distance away by means of the usual detonator.

The shock caused by the explosion of the top section of dynamite sets off the other pieces, the force of the explosion throwing out much dirt and loosening the remainder so that it may be easily cleaned out with a shovel in two or three minutes. The amount of dynamite necessary for each hole depends upon the depth of the hole and the character of the soil in which it is to be made. Rocky soil requires more, of course, than plain earth.

When encased in this body of steel the diver can descend to great depths and work with safety

A Steel Body with Arms and Legs for the Diver

A DIVING suit, recently devised for deep-sea diving, is constructed of steel to enable the diver to work at depths of more than two hundred feet, at which point the pressure is about eighty-eight pounds to the square inch. One new feature of the suit illustrated is the position of the arms, which are placed well forward instead of in the usual place at the sides. This is supposed to give him greater lifting power when weights are to be raised above his head. A telephone apparatus within the suit keeps the diver in communication with the surface at all times.

Safety First as Applied to the Hammerless Gun

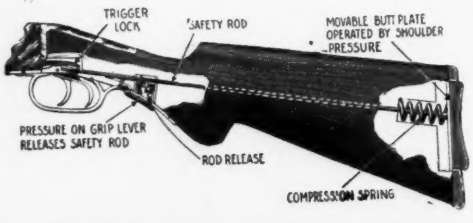
AS usually made, the hammerless gun has a little catch on the tang which operates to lock the triggers of the gun when it is on the "safe" notch. Most guns operate this automatically as the top lever is pushed over. But the catch merely locks the triggers, and the gun can cheerfully jar off from a heavy fall, sufficient to knock the strikers out of notch with the internal sears.

Fine foreign guns have little intercepting sears in addition to the main sears, and these if not deliberately put out of the way by a pull on the trigger, reach over and collar the hammer if it falls from a jar.

An American inventor has improved an old British design by locking the gun against firing until it is both at the shoulder, and is gripped by the right or firing hand. A light rod runs through the stock from a movable butt-plate, which is pressed in when the gun is put to the shoulder, and releases a trigger lock that puts itself on automatically. Another lock is moved by means of a light, easily moved steel slip lying in the grip of the gun. Until both of these locks are moved, the gun cannot be fired.

Locking the firing mechanism until pressure is put on the butt of the gun is a British scheme a quarter-century old, but it is hardly worth its cost because if the gun should fall, as out of a wagon, and hit on the butt, it would unlock itself just in time to fire from the jarring off of the sears that usually follows a heavy blow on the butt of any hammerless. Also, the gun can be fired while resting on the ground, and the muzzle covered by the hand of the shooter. The combination grip and butt safety would guard against any such accident, but the cost of installation is prohibitive.

A gun is never really safe until unloaded.

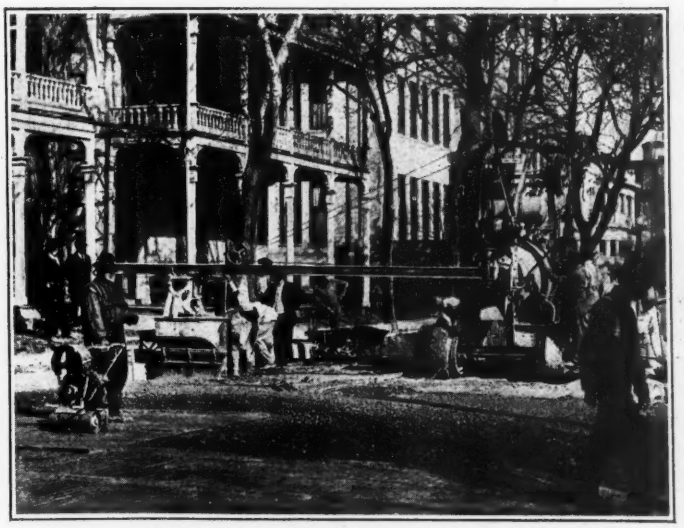


One of the many safety devices for the hammerless gun. It is not foolproof

Hammering Road-Beds to Make Them Even

A one-man-operated machine imparts more than a thousand hammer shocks a minute

MANY concrete road foundations fail because they are made of a porous mortar or of a mortar in which the materials are not properly mixed and bound together. In the first case, water enters the porous mortar, freezes, and cracks the entire surface; in the second case, the surface wears unevenly because there are many patches of improperly bound stone in some places and areas of pure mortar in others. To overcome these difficulties, concrete road foundations are now hammered into place as if by a thousand hammers to form a road-bed which is of exceptional density and uniformity.

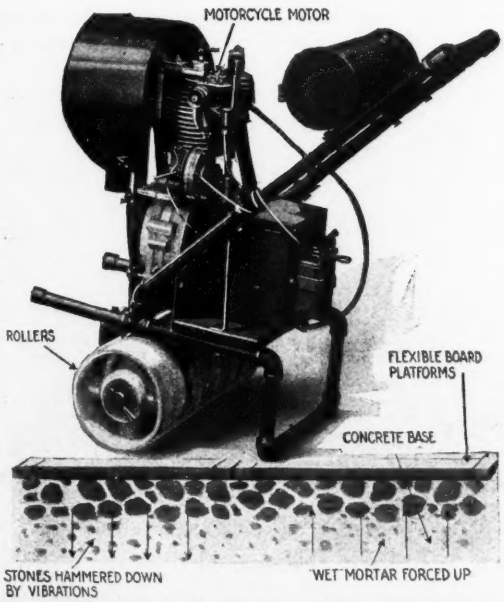


A concrete roadway being hammered into uniformity after the mechanically mixed base has been deposited

An entirely new method is employed in laying the hammered concrete roadway. After the concrete base has been mixed mechanically and deposited in place a layer of screened hard clean stone is spread. On top of this is laid a series of narrow slatted platforms.

These platforms are shaken by a vibrator, which consists of a motorcycle motor with an unbalanced flywheel. The metal frame on which the flywheel is mounted is pushed back and forth by one man. As the unbalanced flywheel revolves it causes the entire framework to vibrate violently, imparting from one thousand to twelve hundred shocks each minute to the wood platforms. These shocks, aided by the weight of the vibrator and the operator, force the hard stones down into the concrete and at the same time drive all air bubbles, cavities and surplus mortar out of the concrete base.

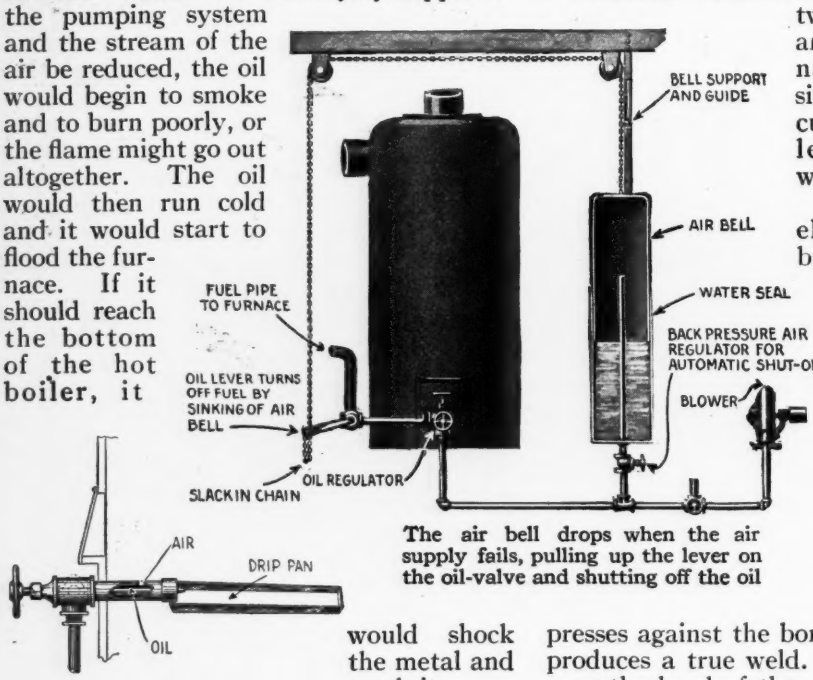
The grout or fluid concrete is forced to the surface. It is later swept off to expose the top layer of rock, upon which the final wearing surface of a special grade of coal tar is applied. The tar serves to keep the moisture in the concrete so that it will not dry out too rapidly and provides a protective coat so that the road may be thrown open to traffic in a few days instead of a few weeks. It also provides a wearing surface which will last several years; after which the dense concrete may be used as the surface or some other top dressing applied. The top dressing of tar is only one-quarter-inch thick and wears evenly.



A motorcycle-motor with an unbalanced fly-wheel supplies the vibration

The Automatic Furnace-Watchman. It Prevents Damage to the Boiler

IN large oil-burning furnaces, so much air is needed to support the oil combustion and to maintain the maximum efficiency that the air must be supplied in veritable streams. Should the least injury happen to the pumping system and the stream of the air be reduced, the oil would begin to smoke and to burn poorly, or the flame might go out altogether. The oil would then run cold and it would start to flood the furnace. If it should reach the bottom of the hot boiler, it would shock the metal and crack it.



The air bell drops when the air supply fails, pulling up the lever on the oil-valve and shutting off the oil

To prevent such a disaster, Edwin Squires, of Claremont, California, has devised a cut-out system which automatically turns off the oil when anything happens to the air supply. It consists of a telescopic air-tank which is operated by pressure of the air itself. This tank, like a commercial gas-tank, contains an upper part, or "bell," which rises and falls with the pressure of the gas inside it. The tank is connected with the air-supply pipe, and the bell of the tank is connected by chains with the valve controlling the oil supply.

The air issues from the pipe surrounding the oil-jet of the furnace-burner. Here it steadily supplies oxygen to the burning oil which issues from the central jet. Should this air supply become reduced, the pressure in the air-tank is lessened. The air in the tank pushes less hard against the bottom of the bell, and it sinks down in consequence. The bell pulls the chain down with it, raising up the controlling arm and shutting off the oil.

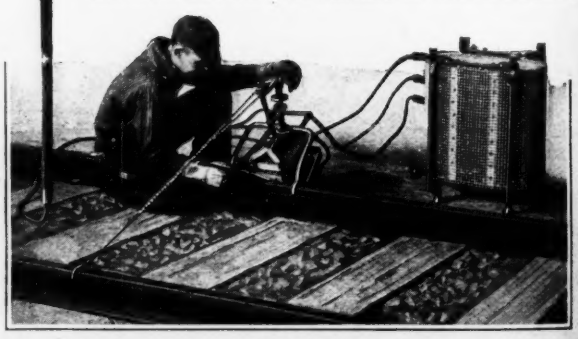
A Portable Electric Apparatus for Welding Track Bonds

IN order to provide a track welder which is cheap enough for the smallest railway, a Western manufacturer has developed a portable apparatus that consists merely of a resistance element which weighs about two hundred pounds, and an electric furnace which weighs sixty-five pounds. The current from the trolley is utilized for welding the bonds.

With the outfit an electrically-welded bond is obtained which will not depreciate on account of the elements. In obtaining this union, neither an arc nor flame strikes the bond or rail. Thus the danger of injury to the bond, rail and eyes is avoided. A heated block of graphite presses against the bond terminal and this produces a true weld. A yoke which sets over the head of the rail and a chain and hook which are fastened to the opposite rail hold the apparatus in a tilted position so that a part of its weight presses the bond.

Two hand wheels on the framework adjust the tilt and vertical position of the furnace, so that the graphite comes into contact with the bond terminal.

The trolley circuit to the rail is completed by closing the circuit breaker mounted in the center of the rheostat and which is controlled from the handle at the bottom.



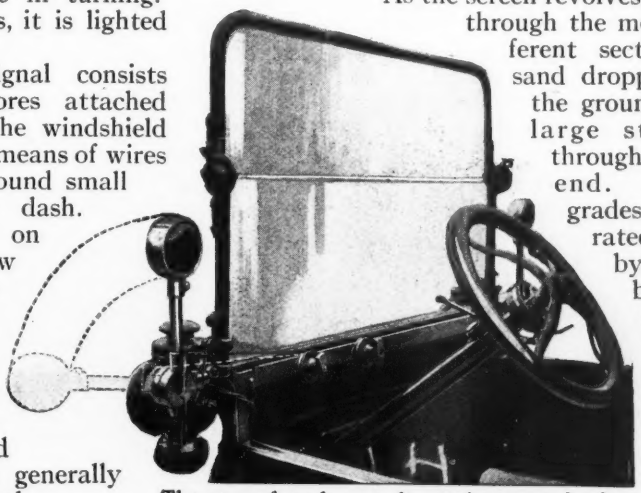
A heavy current taken directly from the trolley wires heats the bond and the rail, welding them together with the electrode and five switch-points

An Electric Semaphore Signal for the Automobile

LIKE an ordinary semaphore, the electrically-lighted automobile signal shown in the illustration drops to a horizontal position to indicate the direction the car will take in turning. As the arm drops, it is lighted automatically.

The entire signal consists of two semaphores attached to the sides of the windshield and operated by means of wires tightly wound around small drums on the dash.

Small knobs on the drums allow the driver to drop either light at will by turning either knob and releasing the wires. Red and green lights are generally used for such signals.



The arms drop by gravity and are revolved to their vertical position by turning knobs

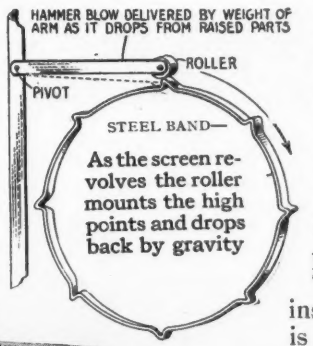
Stock Power Sand Screens for Small Jobs

EASILY movable from place to place on a contracting job, the power-driven sand and gravel screen shown in the accompanying illustration is designed for small jobs where the cost of erecting a permanent screen would be prohibitive but where the old hand methods would prove too slow and too costly.

The screen consists of an open cylinder carried on a shaft at its center and supported on a metal framework with small wheels on the bottom. The cylinder is made in several ring sections over which are bolted semicircular screens covered with wire netting of close and open weave.

The sand is fed into one end of the screen by means of a hopper and chute. As the screen revolves, the sand passes through the meshes of the different sections, the finest sand dropping through to the ground first and the large stones passing through clear out to the end. The varying grades of sand are separated on the ground by means of small boards as shown in the picture.

Another unusual feature of the screen shown is a mechanical screen cleaner working on the hammer or impulse principle. This cleaner consists of an inverted U-shaped frame bolted to the sides of the screen framework over the section having the finest screen. A horizontal arm pivoted to one of the vertical arms of the U-frame terminates in a small metal roller at its free inner end which contacts by gravity with a narrow steel ring around the screen, imparting hammer-like blows to the ring and screen sufficient to jar free any particles clogging it.


HAMMER BLOW DELIVERED BY WEIGHT OF ARM AS IT DROPS FROM RAISED PARTS
ROLLER
PIVOT
STEEL BAND—
As the screen revolves the roller mounts the high points and drops back by gravity

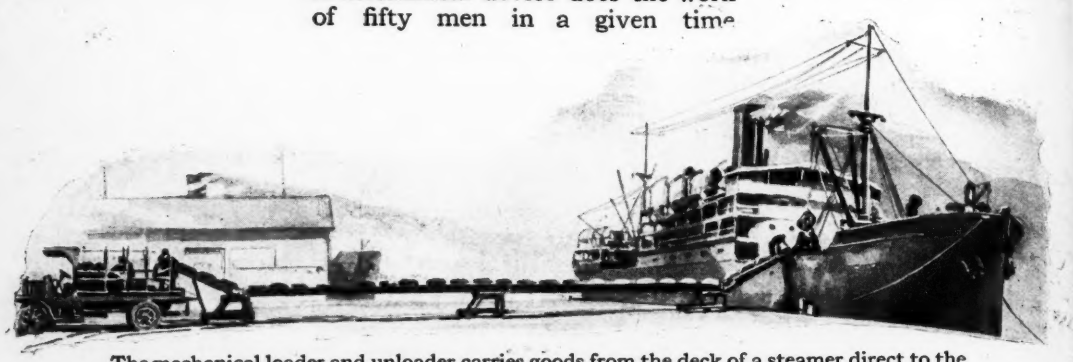
The apparatus may be driven from the lighting current or from a portable engine

"The use of wire screens instead of perforated metal is a new departure in small capacity screens. It has been found that the roughness of the wire netting offers sufficient resistance to the sliding mass to hold it until the part that should sift through has fallen out, thus insuring uniform grading of the material.

The field of the screen i not limited to sand alone It may be used for coal coal screenings and the like

Exit the Stevedore

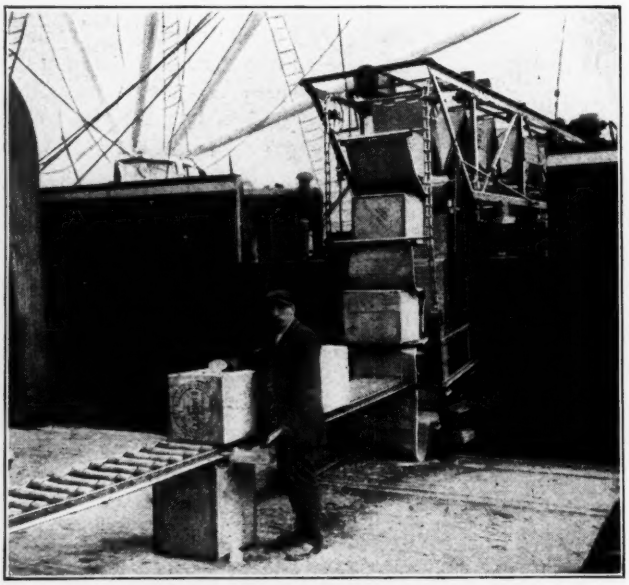
A mechanical device does the work of fifty men in a given time



The mechanical loader and unloader carries goods from the deck of a steamer direct to the truck for final delivery to the wholesaler. It has a capacity of one ton per minute

A COMBINED mechanical loader and unloader which will carry packed goods from the deck of a ship direct to the body of the waiting motor vehicle for final delivery to the wholesaler or to the consumer, with but one handling, is designed to materially reduce the final cost of goods to the purchaser by reducing transportation charges.

The apparatus consists of portable sections of belt conveyors mounted on small stands with castor wheels. These are moved about the wharf or freight station to meet the physical conditions existent, and when made into one continuous conveyor will carry any kind of packed goods from any desired point to any other in remarkably quick time.



The apparatus consists of portable sections of belt conveyors mounted on stands with castor wheels

The apparatus shown has a capacity of a ton a minute. One unloader is thus able to unload a ship having a carrying tonnage of four thousand in about sixty hours or six days of ten hours each. With two such unloaders the vessel could be unloaded in three days, whereas a crew of perhaps a hundred men working in day and night shifts would be required to accomplish the same result and at a much greater cost.

The conveyor sections are simply steel latticed beams carrying endless belts driven by gears through the medium of electric current, steam, compressed air, oil under pressure or by means of internal combustion engines according to the motive power most available. The power is applied to one of the belt sections and then transferred to the one adjacent to it by means of small sprockets and chains on the sides, as shown in the accompanying illustrations.

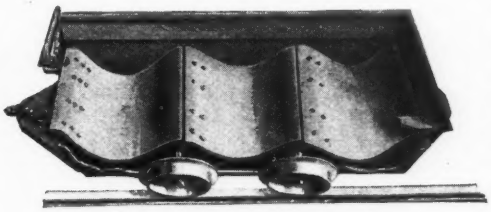
In the case shown, the goods being unloaded travels down a grade from the deck of the ship to the level section on the wharf and then up a twenty per cent incline at the other end directly into the body of the waiting vehicle. If it is not desired to load it directly, it may be stored in piles. The entire operation is performed with but one handling, that of loosening the sling by means of which the bundles are lifted.

A Mine-Car Which Unloads Itself

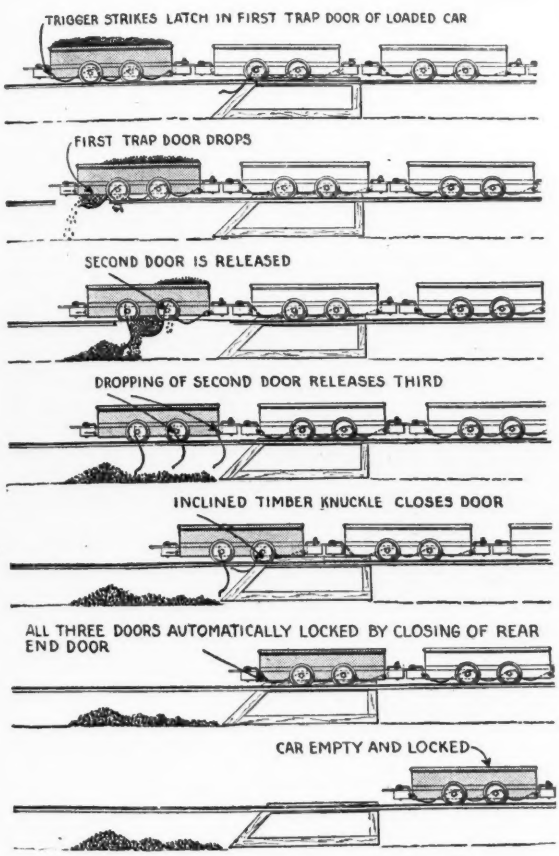
Start the mechanism, and the car will be loaded, driven to its destination, emptied and returned in one minute

A NEW drop-bottom mining car is being used in the larger mines of the country. It operates automatically. It is loaded by automatic chutes; it is driven in trains by an electric motor and it is even dumped by mechanical trippers. The car is of larger capacity than previous types, although the distance from its top to the rails is only a little over two feet.

The bottom of each car is divided into three sections. As a train of cars loaded with coal passes over a storage pit, a rail projecting upwards from the track operates a trigger at the rear of each car. The trigger moves sideways and releases the bottom section of the car next to it. The weight of the coal in this section immediately forces the section open. Just as soon as this happens, the middle section is also released. When this middle section has swung open, the construction of the bottom of the car is such as to release the remaining section also.



The three sections which comprise the bottom of the automatic dumping car


TRIGGER STRIKES LATCH IN FIRST TRAP DOOR OF LOADED CAR
FIRST TRAP DOOR DROPS
SECOND DOOR IS RELEASED
DROPPING OF SECOND DOOR RELEASES THIRD
INCLINED TIMBER KNUCKLE CLOSES DOOR
ALL THREE DOORS AUTOMATICALLY LOCKED BY CLOSING OF REAR END DOOR
CAR EMPTY AND LOCKED

A car loaded with coal passes over a projection above the tracks. A trigger is operated and the three sections at the bottom of the car open one after the other. The car then moves over a sloping beam and the sections slide up this and are closed and latched once more

Thus, in a very few seconds all the sections will have swung open and all the coal will have been dumped. The car then travels onward to another mechanism. This automatically closes the bottom sections of the car. It consists merely of a sloping beam against which the opened sections slide as the car moves along. The sections slide to the top of the beam one after the other. They are thus raised up past their catches and successively closed.

The cars are drawn from the mine by a small electric locomotive. In some mines, however, neither motor nor mule is required to draw the loaded cars to the storage pits. Instead the roadway of the cars is made sloping. The weight of the loaded cars is sufficient in these cases to furnish the drawing power. In the run back to the mine the locomotive is, of course, used. The cars are empty on this return trip, so that little electric power is needed.

The cars are of all-steel construction and will last for many years. Besides their simplicity of operation, they can haul the coal far more quickly than can other types. From fifteen to twenty two-and-a-half-ton cars are operated in one minute without requiring the slightest attention after being started.

Making Floods Work

How Water Users' Associations coöperate to utilize streams

THE ideal river is one that has the same flow every day in the year. But, with rare exceptions, rivers do not flow that way. At one season of the year, the river runs bankful, or even overflows and causes enormous damage and suffering. And then, a few months later, it is shrunken to a point where navigation is at a standstill, water power plants must shut down, water supplies are inferior and sometimes inadequate or unusable, and sewage and trade-wastes are so concentrated in the scanty flow that a dangerous nuisance exists.

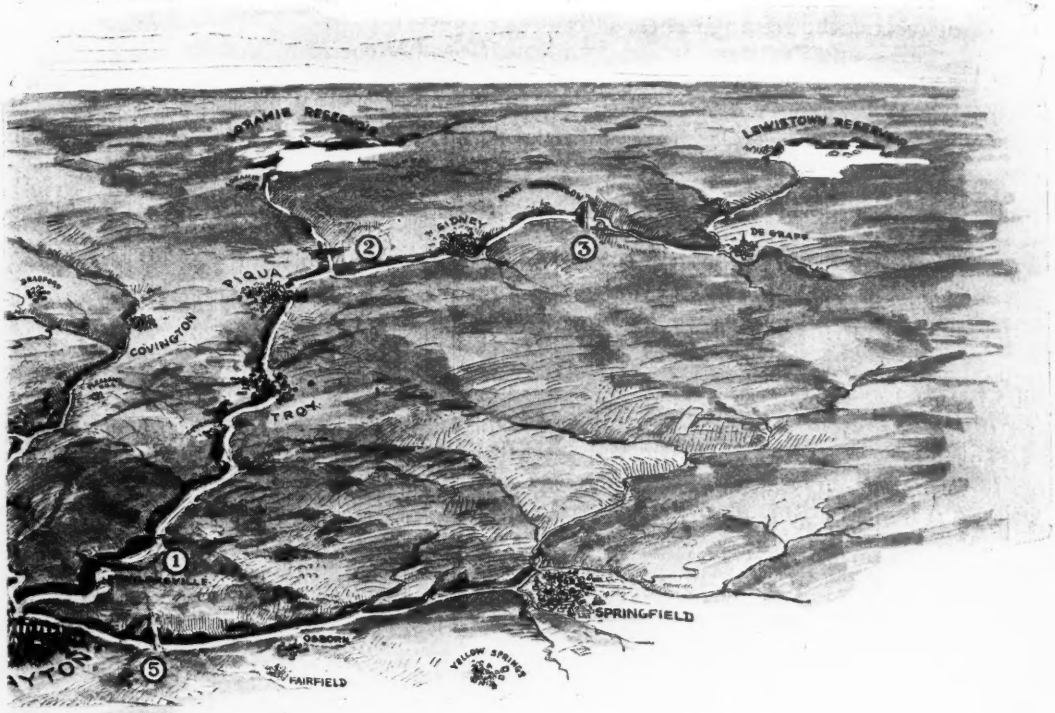
Regulating the flow of a river so that the water formerly wasted in flood times will be available during the dry weather is a form of water conservation that has been very thoroughly developed in Germany, both as to the engineering works required and the necessary legal machinery to provide for their construction and operation.

In the valleys of many of the German rivers, a large part of the waste water is stored in great reservoirs and let out during times of low water. It is thus changed from an agent of destruction to a benefaction to every community in the valley.

There is nothing new in the idea of storing floods and using their waters dur-

ing the dry season. The ancients had great works of this kind on the Nile and the Euphrates. We have the largest in the world in the United States today.

The chief point of interest about many of the works of this kind built in Germany is the manner in which the interests benefited coöperate in paying for their construction and maintenance. This cooperation is effected under the provisions of a law passed in 1879, which provides for the organization of water users' associations.



In the valleys of the Miami and Scioto Rivers, near Dayton and Columbus, several conservation districts for preventing floods have been formed under the Conservancy Law of Ohio, passed in 1914 as a result of the great flood of March, 1913, which almost destroyed the locality

The most important of these associations is the one made up of the water users of the Ruhr Valley. The Ruhr is a large tributary entering the Rhine not far below Düsseldorf. It is about one hundred and forty miles long, and drains an area of a little over two thousand square miles. It flows through the great iron and steel manufacturing center of Germany, around Essen (the home of the Krupp works), and is extensively used for domestic and industrial water supply and for water power. In 1899 a voluntary association of the water users was formed to coöperate in financing works to increase the low-water flow of the Ruhr. This was called *Ruhrtalsperren-Verein* or Ruhr Reservoir Association.

In 1904 an exceptionally dry year made it apparent that additional storage on a large scale was necessary to prevent a disastrous water shortage in the valley. After exhaustive investigations the Ruhr Association decided to build at its own expense a great reservoir on the Möhne River, one of the principal tributaries of the Ruhr. Work was begun in January, 1908, and the reservoir was completed in December, 1912, in exactly four years.

The Möhne Reservoir is the largest on the Ruhr basin, and the second largest in Europe. It has a capacity of about 4,600-000,000 cubic feet and controls the run-off from about one hundred and sixty square miles. The dam is built of rubble masonry, arched up stream, and is one hundred and thirty-two feet high, twenty feet wide on top, one hundred and twelve feet wide at

the base, and two thousand and one hundred feet long on the crest. The total cost of the reservoir was about $5,000,000.

A large water power plant has been constructed below the dam, to convert the energy of the water as it is released from the reservoir into electric power. As this plant will in a few hours use up all the water available for an entire day, a balancing or equalizing reservoir has been built a short distance below the power house to receive the water discharged from the turbines and deliver it uniformly throughout the twenty-four hours to the stream below.

The other ten reservoirs on the Ruhr Basin were built between 1894 and 1912, and vary in capacity from sixteen to six hundred and sixty million cubic feet. The dams are all of rubble masonry, arched upstream like the Möhne Dam, and vary in height from sixty-four to one hundred and thirty-three feet.

A project much like the original Ruhr Association has recently been proposed on the Naugatuck River in Connecticut. Twenty-five corporations with manufacturing plants along this stream have agreed to cooperate in the construction of three storage reservoirs with a combined capacity of 1,736,000,000 cubic feet at a cost of several million dollars. The purpose of these reservoirs is to increase the low-water flow in order to overcome the present shortage of water for industrial purposes.

The Beaver River Valley in western Pennsylvania presents ideal conditions for the formation of a water users' association modeled after that on the Ruhr River. The low-water flow is entirely inadequate to supply the thickly populated manufacturing district bordering the river. The State Water Supply Commission in 1912 showed that a storage reservoir impounding about eight billion cubic feet could be built at a cost of about $1,600,000.

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Looking into the little inclined mirror in front of him the soldier sees the image of the rifle sights and the view beyond, thrown from the mirror above

Combining the Periscope with the Military Rifle

"PERISCOPE, an instrument for seeing over intervening objects"—so the dictionary says.

About three hundred ingenious and hopeful inventors have gone to the Patent Office and then to various military headquarters with different designs of periscope-sighted rifles since the war began. Most of these schemes were more ingenious than practical; few of them had enough originality to be worth much.

The rifle attachment here illustrated is one of the most workmanlike and practical applications of the idea of so rigging a rifle with a pair of mirrors that one can "lay" it accurately on the other fellow while remaining snugly below the trench level and exposing only the rifle.

The primary principle of all such arrangements is that if you place a mirror on a line with the sights of the rifle and arrange it at the proper angle, and have another mirror a sufficient distance below, the second mirror picks up from the first one above the image of the rifle sights and reveals the spot where the enemy is supposed to be.

Gazing at the little inclined mirror in front of him, the soldier sees the reflection of the rifle sights and the view beyond the rifle, sent down by the mirror placed at the top end of the tube. The rifle is aligned and held against the kick of firing by the detachable piece fastened to the rifle stock, while it is fired in the normal way. The soldier is therefore able to take accurate aim without exposing himself above the trench parapet. Tommy Atkins aided by Mother Necessity, evolved a dozen different modifications of the periscope idea, from two bits of pocket mirror, and some sticks. Try it yourself with a piece of cut-out stove pipe and two mirrors placed at proper angles at top and bottom.

Four Motion-Picture Shows in One

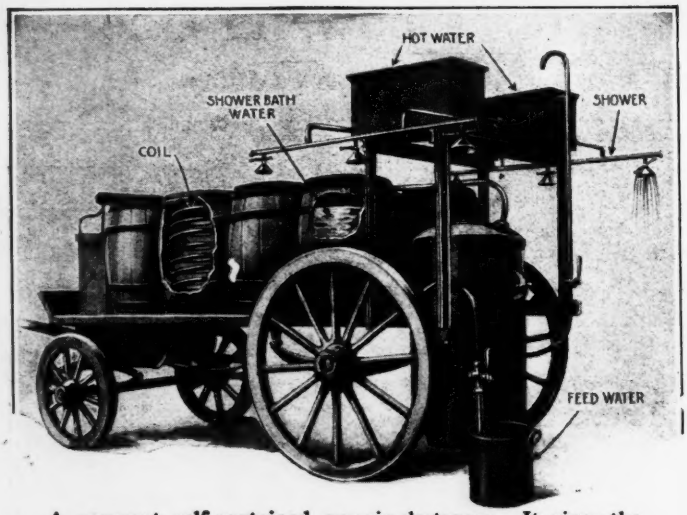
Thus Kansas City accommodated an extra size audience

The screens are arranged in a cube and suspended from the center of the ceiling so that the pictures may be seen from all sides of the hall

Here projection screens were used, one on each wall of the hall, and the audience was divided into four sections, each facing its own screen

THE largest of all motion-picture exhibitions was staged recently in Kansas City, in her mammoth Convention Hall before five different audiences aggregating sixty-seven thousand persons. The newspaper which gave the exhibition sent out more than two hundred thousand invitations. To enable the great audience which filled Convention Hall to see the pictures, four screens were erected in the center of the big hall. Each screen measured seventeen by thirteen feet. The pictures could be seen from all directions. The operators timed the running of the pictures. A bell was rung when the end of every one hundred feet of film was reached, so that each operator knew whether he had to speed up or slow down. The four screens fastened together in the center of the arena formed a cube open at the top and bottom. Below this little cube of screens was a space which accommodated an orchestra of thirty-five pieces.

Another unique method of projecting four views of the same picture simultaneously is illustrated in the second picture. Instead of the screens in the center of the hall a large projection room was built at this vantage point and the screens were placed one on each wall of the hall.



A compact self-contained vermin-destroyer. It gives the men a shower bath at the same time that their clothes are being subjected to the disinfecting vapor treatment

Writing Paper Made from Spinach Stems!

THE chemists are even contemplating using the stems of spinach for making paper. According to a French horticulturist, Monsieur de Noyer, spinach stems contain forty-six per cent of cellulose. He claims to have actually made paper from the vegetable, following the methods of the Grenoble paper-making school. If the waste portions of spinach are used for this purpose, he believes it will produce a most satisfactory writing paper, which will cost considerably less than the present high-quality grades.

Getting Rid of Vermin Which Make Life Miserable in the Trenches

IT would seem that fighting a human enemy and being bombarded with shrapnel and rapid fire guns would be sufficient to make life miserable for the fighters in the war zone without any additional annoyances. But the soldiers have still another enemy to fight, in the form of vermin. These are considered to be not only a nuisance but a menace to health.

Radical means have been employed to get rid of the vermin; but the usual methods involve the installation of cumbersome apparatus which it is difficult to transport from place to place. A device which has recently been designed to meet the need, however, is mounted on a small truck, which takes care of the transportation problem. The apparatus consists of barrels of disinfectant and a vaporizing condenser. The liquid is heated to 106 degrees and vaporized under a pressure which is determined by the size of the article being subjected to the vapor bath. At the back of the truck are two pipes for shower baths leading from the hot water tanks.

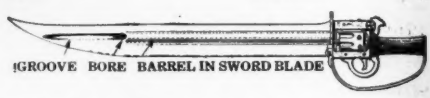
Combining the Sword and Pistol in One Weapon

A PENNSYLVANIA man has evolved a combination sword and pistol, in which the barrel of the pistol is part of the sword blade, which is made a little thicker in the center to allow a hole to be bored, through which the bullet passes.

Between hilt proper and blade is mounted a revolver cylinder, with trigger and guard below it, and regular revolver firing mechanism, all part of the hilt, the trigger guard being within the hand-guard of the sword.

The user may cut and thrust to his heart's content with a weapon that is practically a sword, but when the other fellow proves a bit better fencer, the user has merely to slip his finger into the guard of the trigger, give a pull, and shoot his astonished opponent with what seemed to be only a sword.

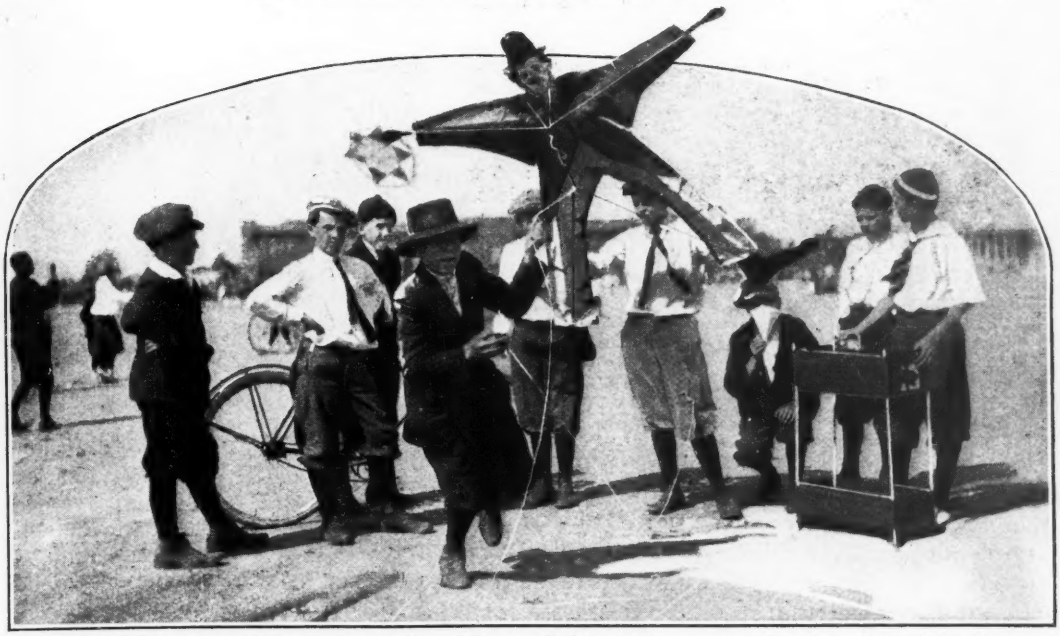
The barrel of the sword-pistol is part of the sword blade



The blade-barrel and the cylinder are fastened to the hilt with hinges in such a manner as to allow the gun to be "broken" to eject the shells.

Flying Kites for Prizes

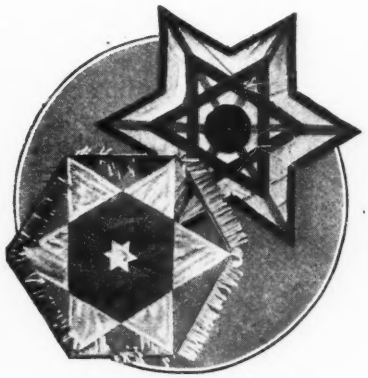
Los Angeles stimulates an interest in kite construction by holding an annual tournament



"Charlie" takes a trip skyward. These kites, called boy kites, are awkward and ungainly, but they appeal to the youngsters. They are not nearly so difficult to make as might be supposed

EACH year the boys of Los Angeles gather on the Exposition Park grounds and hold a kite tournament. The events are scheduled for two o'clock on a Saturday afternoon, but some of the boys put in an appearance at nine o'clock in the morning. By the time the tournament starts, contrary to the old adage, the early birds instead of winning the prizes have no kites to fly. They try out their kites so many times during the early hours that the kites go to pieces.

But the sky is fairly bedecked with flying contraptions of all descriptions. Big kites, boxes, miniature editions, butterflies, birds, animals, fishes, Charlie Chaplins, and other kinds innumerable make up the display. Each year there is a greater variety. The tournament has been an annual event for nine years. There are fewer large kites now than in former years, largely due to the risk of breakage incurred in transporting them to the flying grounds. However, some large ones still appear and they never fail to call forth admiration.



Star kites vie with the tailless kite for popularity

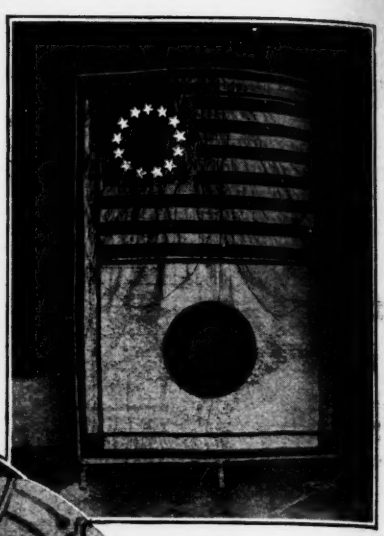
Miniature aeroplanes are giving way to kites, which have a more fantastic appearance; but the number of hot-air balloons is decreasing. The temptation to ascertain the effect of a nicely aimed rock on a frail balloon is too strong to be resisted. Consequently the balloons must be guarded against attack. In the tournament held last year many patriotic balloon and kite designs appeared. Most of these had some reference to peace.

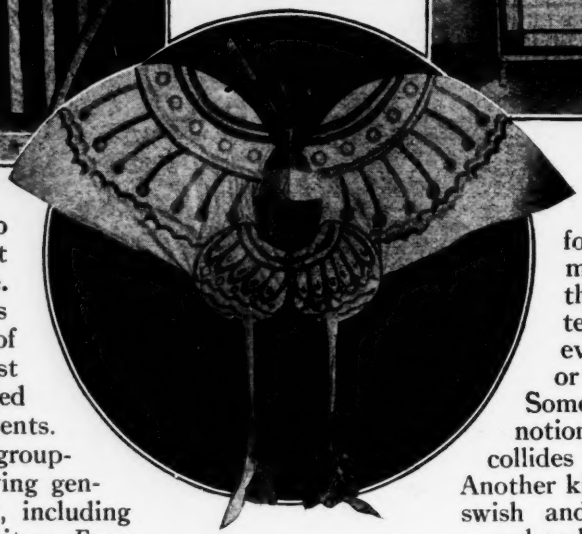
In preparing for a tournament, an announcement is sent to each school in the city, giving the time and place of meeting. The classes and events are scheduled so that the boys may know what to plan for. Usually suggestions accompany the bulletins that are sent out from time to time. A registration is held at

At left: A "peace" kite, bearing the inscription: "I stand for peace. I am neutral. I fear none of them"

At right: A Japanese square kite. No Oriental kite is complete without the Japanese sun

Below: The most artistic kite in the air last season. Its tails were from six to eight feet long





each school, so as to plan the tournament on the proper scale. However, no one is kept out for neglect of registration. The last tournament comprised about seventy events. The events were grouped under the following general heads: *Artistic*, including the best decorated kites; *Form kites*, calling for bird, animal and flower designs; *Balloons*, including parachutes and banners; *Dragon kites*, including the tailless dragon, Chinese dragon and the Japanese kites; *Aeroplanes*, including both kites and gliders. A *Construction* prize was also awarded for structural ingenuity.

These events were further subdivided. For instance, the best decorated kite on the ground was not necessarily the best decorated kite in the air. In the strong pulling contest there were kites under and over four feet high. Then there were contests for strong-pulling box-kites, compound kites, and various other free-for-all events.

In the races, prizes are awarded for the highest flight made in one minute, three minutes, and ten minutes. In such events there is more or less confusion. Some kite takes a sudden notion to go sideways and collides with another kite. Another kite goes up with a swish and then darts as if scared and whirls around and around, playing havoc with two or three kites near it. But some kites go up, up, up. The boys get excited and play out the string too quickly. Others fail to get the kite up before the limit of time. It is indeed an exciting contest for both kite-flyers and spectators.

Each boy has a helper to hold his kite. When the starting signal is given the helper releases the kite, and the boy runs into the breeze for a short distance until the kite climbs fairly high. Then he stops and plays out string as fast as the kite will take it. In the short races it is easy to stand at a distance and determine the

A square box kite with extended side wings made on lines resembling the French war-kite

two highest kites. But for the ten minute-race one must get off quite a distance in order to follow the kites and trace them to their respective owners.

The quarter-mile dash is "run" with reels; it is even more exciting than the quick high flights. The string is let out for a quarter mile; then it is attached to the reel and an unmerciful winding begins. The kite mounts up, up, up until it stands almost overhead, and still the boys wind with all the vim in their bodies, which is considerable.

"Charlie" up in the air. As a kite figure he isn't very animated

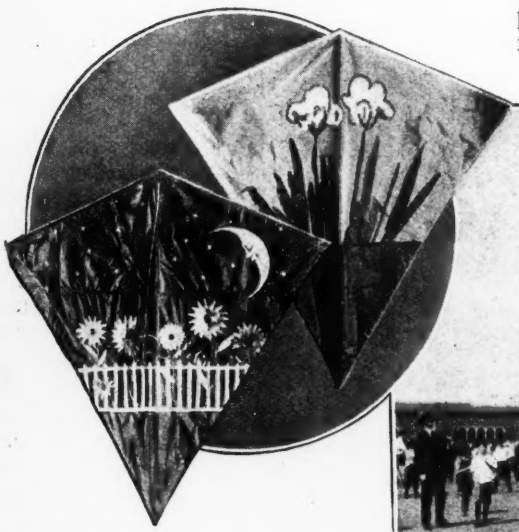
When the winding is in operation a kite may rebel, dart to earth and bury its sorrow. But usually some friend shouts to Johnnie or Ralph to save his kite from self-destruction. If the kite plunges to the ground it may not be dragged in, but must be raised to continue in the contest. Great is the shouting when the first kite comes in.

The judges are usually chosen from the teaching body. When an event is judged, one record is made on the judge's blank and a duplicate is made out for the winner. He takes his slip to the badge committee and receives in exchange the coveted token.

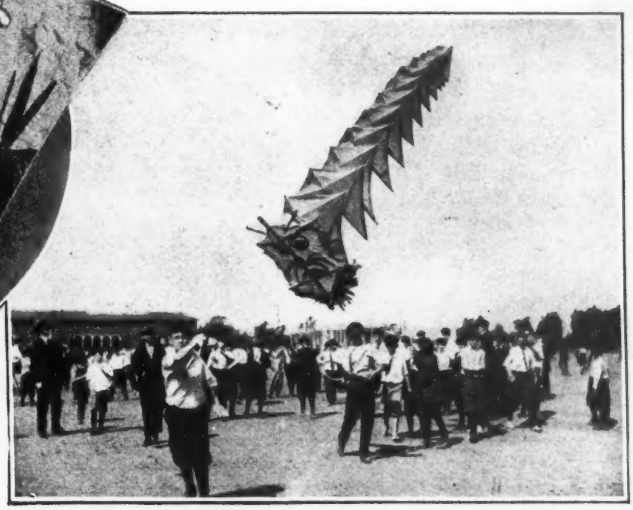
In the tournament held this past season the kite representing a giant insect was considered to be the most artistic flyer in the air. The design of this particular kite stood out well far up in the air. The two tails added graceful lines to the lithe body as it swayed to and fro in the breeze.

The framework for this kite, shown in Fig. 1, is made of bamboo not more than 1/16 in. thick and ¼ in. wide. There is an extra spine that bows out to the front throughout the body portion. Toward the top it is split to form the two spirals. The split begins at *D*, and the spine must be wound below this. Some use thread for winding; others use strips of rice paper with paste. The paper shrinks and draws the windings very tight. The bamboo is curved by heating it over a flame and bending it while hot.

The wing pieces *B* and *B* are lashed together at *X* and are wound to *Y*, where they separate and form the lower circles secured at *Z*. Continuous pieces *A*, *A* are crossed and extended to form feelers. The paper on the lower edges of the wings is not turned over the string as in the tailless



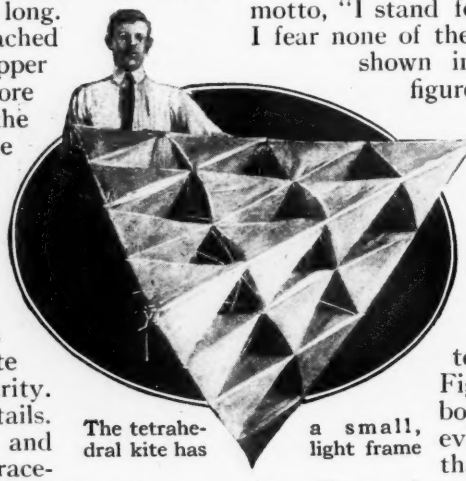
Flower-garden kites. The designs are original. When high in the sky, with the sun behind them, these kites were very effective



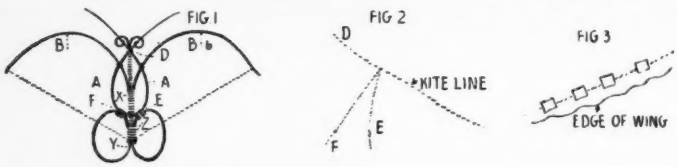
The dragon kite beginning to hump up its back. The boy wears cotton gloves to protect his hands from the string

cover, but little patches of paper are pasted over the string (Fig. 3), leaving the edges free to flutter in the breeze. The tails are from six to eight feet long. The bridle may be attached as in Fig. 2. The upper string should not be more than half the length of the two lower ones. The bridle is fastened at *D*, *E* and *F*.

The tailless kite is perhaps the most popular. Its framework is suggested by Fig. 4. The star kite follows close on the tailless kite in point of popularity. Most star kites have tails. Sometimes two, three and more tails float out in graceful parallel curves from the kite. Geometrical designs are usually preferred. The



The tetrahedral kite has a small, light frame



Details of frame constructions. The dark lines represent frames and the dotted lines strings

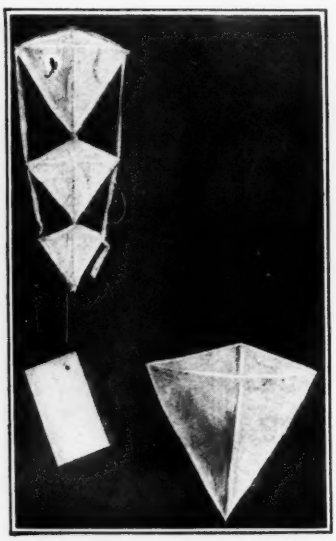
Japanese square kite has a light frame of bamboo. There are usually a vertical spine, two diagonal pieces that run from corner to corner, and a series of horizontal ribs, as shown in Fig. 5. The whole kite is bowed forward (*B*, Fig. 5) and strings are attached three to each side, one to the middle of the top and bottom and one to the center.

The "peace" kite illustrated has for its motto, "I stand for peace. I am neutral. I fear none of them." The framework is shown in Fig. 8. The human figure kites are always an attraction. They are awkward and ungainly but therein lies the appeal. One illustration shows the inimitable "Charlie" leaving on his aerial trip and another shows him "up in the air." His skeleton is represented by Fig. 7. Of course the larger box kites are always in evidence, especially those that can be folded or rolled. One illustration shows a box kite with extended side wings, resembling a French war-kite. These kites are strong pullers.

The dragon kites are among the most interesting novelties of the contest. The one illustrated is of the tailless type and is a splendid flyer. The rear end usually flies higher than the head. The cords between the different kites making up the dragon are all the same length, so when the head is tipsy all the rest are tipsy too. The boy flying this powerful dragon has to protect his hands with cotton gloves.

The tetrahedral kite is one of the newcomers in the contest. The wood of the framework may be in very small strips and yet be perfectly rigid on account of the bracing construction. The kite may be made in sections, but the boys are usually too busy with other affairs to stop long enough to make tetrahedral kites.

Two kites were decorated with aerial flower gardens. The designs show up well—picket fence, flowers, moon and all. With a strong light in the background these kites were very effective.



A compound tailless kite with telescoping sections

This Machine Tells You How Much You Ought to Eat

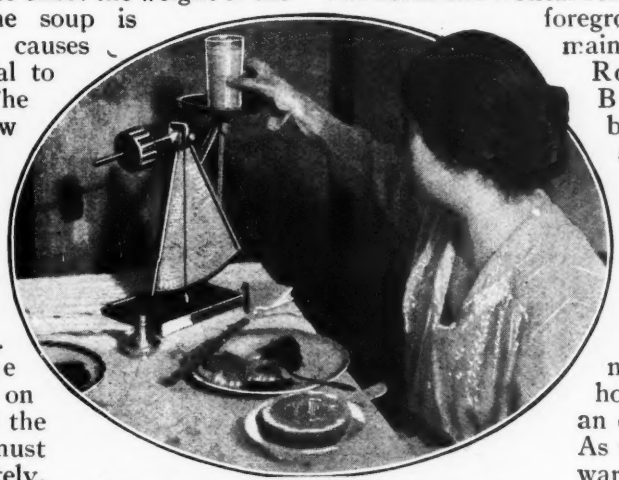
HERE is a machine that tells you what to eat, or, more accurately speaking, how much you are eating in the terms that the chemist uses to measure food values.

It is a calculating scales from the dial of which one reads the number of calories and the number of grams of protein in the portion of food on the scale pan. The principle is similar to that of the commercial computing scales, which, if the price per pound be known, shows by the indicator the retail price of the amount of merchandise being weighed.

From a dietetic standpoint it is meaningless to weigh food in pounds. The proper unit of the fuel value or energy yielding power of food is the calorie. Lettuce contains 65 calories per pound and olive oil contains 4200 per pound.

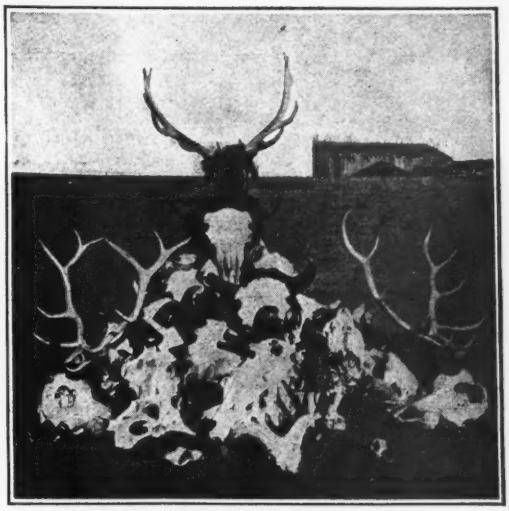
Wide differences are also found in the protein or flesh building contents of foods. Pure oils, starches and sugar contain no protein at all and a Robinson Crusoe would starve to death if his desert island were one vast mountain of starch and sugar with fountains of purest olive oil, honey and maple syrup gushing from its side.

So the hungry man who wishes to eat scientifically sits down to dinner and places his soup plate on the scale pan. He first adjusts the tare weight (on the worm thread at the left) to offset the weight of the plate. Then the soup is poured in, which causes the fan-shaped dial to swing sideways. The scientific diner now finds the word "soup" under the heading "Calories" and reads directly from the scales the number of calories he is to consume. Protein can be read separately on another portion of the dial. Each food must be weighed separately, for the machine can't think straight if one tries to weigh butter and bread together.



The calculating food scale which measures the energy value of each dish that you eat

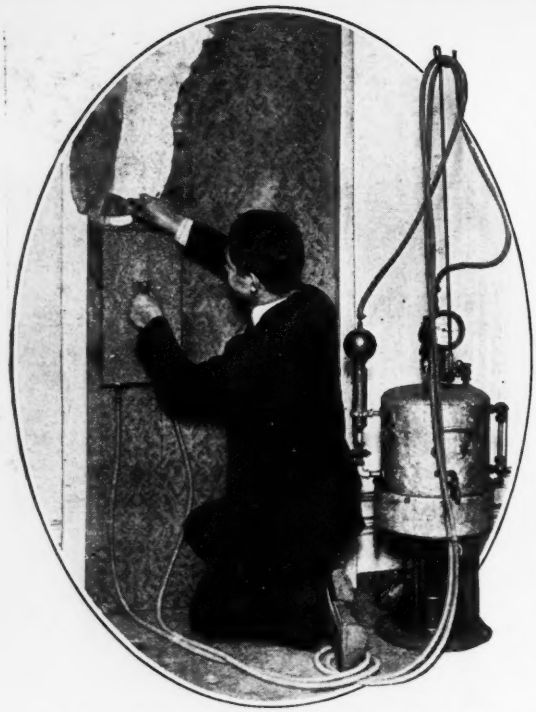
Such a calculating food scale should find practical use in the numerous investigations and demonstrations now being conducted to determine the cost of living.



A collection of buffalo skulls and elk antlers, found recently in a secluded valley in the West in a remarkable state of preservation

Relics of the Almost Extinct American Buffalo

NOW and then, through the West one finds such a collection of horns and heads of the now almost extinct American buffaloes, as is shown in the picture above. The massiveness and strength of the buffalo is phenomenal. Were a large steer's skull placed alongside the big buffalo head at the right-hand corner of the picture, it would appear puny and shell-like by comparison. The horns and frontal bone in the immediate foreground are the remains of the head of a Rocky Mountain Bighorn. The branching antlers shown belonged to a one-time majestic elk, the largest and most lordly of the American deer kind, with the exception of the moose. The horns to the left are an especially fine set. As the elk is far more wary than the buffalo and moreover does not travel, as a rule, in large herds, he has not suffered the practical extinction which has befallen the buffalo, and now all the Western State game laws afford him adequate protection. His distinctly American name is Wapiti.



A heated moistened pad is guided over the wall and the old paper peels off in strips

Steam-Heat the Wallpaper and then Tear It off in Strips

REMOVING old wallpaper from a room is always a tedious job; but a steam-heating appliance has been invented by Nathan Rubenstein which does away with the inconveniences of other methods. The appliance, first of all, can steam-heat the paper to a very high temperature. The steam slightly moistens the paper at the same time, so that an entire strip can be peeled off at once.

The steam, generated in a boiler by a gasoline burner, is conveyed by a hose to a sheet-iron block which is brought flat up against the wall. The block is perforated and the holes are covered by a cloth pad. Some of the steam which is fed into the block will penetrate through the holes and slightly moisten the cloth. When the hot moist cloth is guided slowly over the wallpaper, the heat cracks off the glue, the moisture helping the process, and the paper can be readily skinned off without the usual slopping.

Measurements of the Valleys of the Deep

ALMOST peculiar fact about the oceans of the world is that the largest depressions are to be found near the coastlines. The three largest of these are all in the Pacific, two of them being near island coastlines. The "Swire Deep," just off the Philippines, measures no less than thirty-three thousand feet from the surface of the ocean to the bottom. This is just three thousand feet deeper than Mount Everest, in Asia, is high. The "Aldridge Deep" in the South Pacific ranks next to this, being nearly thirty-one thousand feet deep. The third is the "Tuscarora Deep" near Japan, which soundings indicate to be twenty-seven thousand, six hundred feet in depth. This would then make the bottom of the Tuscarora Deep over two and three-eighths miles below the average level of the bottom of the ocean.

The Newest Barrel for Storing Dry Stuffs Is Collapsible

NO picnic is complete without a collapsible aluminum drinking cup. The latest adaptation of the idea assumes the form of a collapsible barrel or cask for packing or storing articles such as nails, horseshoes, vegetables, or anything that does not require a waterproof receptacle.

The barrel, when flattened out, may be stored in any convenient nook or corner, or on a shelf and will take up little room. To open it out for use it is necessary only to pull out both ends. There are five sections ordinarily, although the number of sections is not arbitrarily limited. These sections lock automatically when they are pulled out into position, so that when the barrel is moved or rolled about there is no danger of their collapsing of their own accord.

In the head of the barrel is a panel which, besides reinforcing the head, is used to receive addresses when the barrel is used for shipping purposes, or for information to clerks in the shop or storage house concerning the contents, or for advertising matter.

Above: The barrel opened out for use. Below: The sections telescoped for storing away

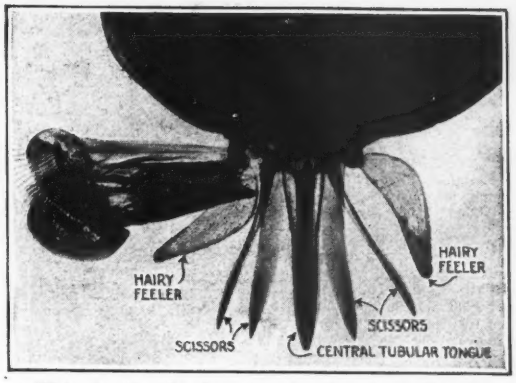
Making Artificial Cream That Rivals the Original

WITH natural cream at thirty-five cents a pint, it is now cheaper to make your own cream. Two Chicagoan chemists have discovered a process whereby the supply of skimmed milk may be converted into cream. Some sugar is first dissolved in the milk. Lecithin, a substance obtained from the yolks of eggs, is mixed with melted beef or butter fat. The two mixtures are then poured into a pot and heated and thoroughly whipped together. When a uniform, creamy mixture has been obtained, it is pasteurized, cooled and set aside until wanted. The result is a readily digestible and a highly nourishing cream.

Like a Combination Tool Is the Blood-Sucking Apparatus of the Horsefly

WHEN a horsefly alights on a horse, he walks around looking for a tender spot, and this he finds with his hairy feelers. Then he cuts a hole with the scissors shown on each side of the central tubular tongue.

An ordinary lead pencil cannot be sharpened to a point without sharpening the lead. So it is with the tubular end of this tongue-like extension of the horsefly. Nature has provided it with barbed, piercing "derrick ropes." The fly inserts these sharp points into the horse and then pulls back on them. The barbs hold and the fly's tongue is forced down into the horse's flesh. But if the hole has already been made, then it is not necessary for these elaborate tools to be taken from the sheath in which they are placed within the tongue or proboscis. The blood is sucked up by the tongue in practically the same way as by other forms of flies.—EDWARD F. BIGELOW.



This is the business end of a horsefly—a wonderful combination tool consisting of scissors, piercing barbs, and a sucking tongue

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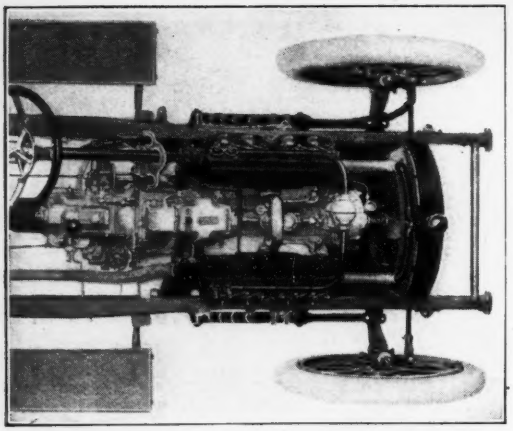
Two Hats with but a Single Crown and but a Single Cost

BEHOLD! The hat problem—or one phase of it—has been solved. The ingenious young woman on the left can have a large-brimmed hat or a short-brimmed one, according to her personal taste or to the need of the moment, simply by adjusting the crown over the brim she prefers and snapping the fasteners. If she is going for a tramp in the sun, her broad-brimmed hat will be required; but if she is to travel through New York city in the subway during the rush hours—presto! a change is made.

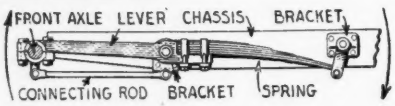
The idea is capable of a number of variations. With separable frames of buckram or wire for both crown and brim, any number of coverings may be used with varieties of trimmings, and such a wealth of headgear will result that one's friends and even one's family may be mystified as well as delighted.

Needless to say the initial cost of the original hat-and-a-half is nominal, considering the multiple duty to be performed.

The crown and brim are separable and the brims are interchangeable. Four snap-fasteners are provided for joining the two sections together



All violent vertical movements are taken up before reaching the body



One of the Longest Tunnels in the World Is Planned for New York

THE plans which Science has conceived for the future, and which are being rapidly proved practical, include developments on land and sea, in the air and even under the land and sea. The tunnel system for carlines and for aqueducts has made the subterranean area of some cities as interesting and intricate as any parts of the surface.

If present plans of the Board of Water Supply of New York city do not miscarry, one of the longest tunnels in the world will soon be constructed to conduct about three hundred million gallons of water daily to the Catskill aqueduct. The tunnel will be shaped like a horseshoe and will be lined with concrete.

A New Automobile Spring Which Takes Up Shocks

A NEW automobile shock-absorber has been invented by Robert E. Olsen, of Seattle, Washington, which is designed to take up the shock before it reaches the body of the car. He provides two springs for the rear and two for the front wheels. Each of the four springs is attached to the chassis frame by two brackets, and the brackets, in turn, are provided with studs upon which are mounted levers which extend to the front and rear axles respectively.

The forward end portion of each of the two levers which serve the rear wheels is equipped with rollers mounted on pivot pins—the rollers engaging both sides of the leaf springs. The leaf springs are connected with the chassis by means of brackets for the front portion and arms for the rear portion. Thus, all violent vertical movements are communicated from the wheels to the lever and to the leaf springs without directly affecting the chassis. Bumps, therefore, will tend to lower the body of the automobile instead of raising it, but so slightly that the effect will be neutralized and the occupants of the car will scarcely be conscious of it; which is just what the inventor intended.

Vacuum Cleaning by Foot Pressure. You Walk on the Bellows

THE fact that there is no electricity in your home need not hinder you from using a vacuum cleaner. A novel cleaner has been brought out which can be operated without electric power and without other exertion than required for walking up and down the floor. Pumping-bellows are attached to your feet, and you are assured of some profitable exercise during the cleaning. A compression spring, provided just under the heel, does the work.

The guiding handle is fitted with a nozzle and a dust filter like those on other vacuum cleaners. The air hose which leads from these, runs to the foot-bellows, as the illustration shows. Each of the two bellows has clamps for attaching it to your foot.

Walking on the bellows forces air up from the carpet, carrying the dust with it into the cylinder

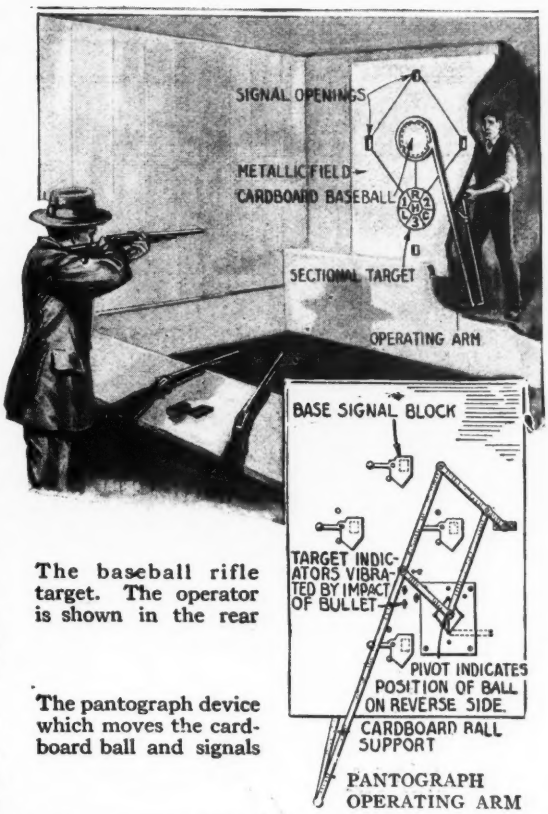
By lifting up and down on the bellows, as you would do in walking, air is forced up the nozzle from the carpet. The dust from the carpet is carried up through the apparatus with the air. But on reaching the filter the dust falls and settles down in the cylinder.

Playing Baseball with Rifles

An amusement park device that will enable a fan to play his own game

SOME irate baseball enthusiasts would like to frequent shooting galleries regularly, provided the targets were umpires and the rifles powerful enough to do real damage. The game illustrated does not offer that opportunity. It affords a means, however, whereby one may exercise his skill as a marksman and engage an opponent in a brisk baseball contest with the rifle.

The result of every shot, hit or miss, is flashed on the board in baseball terms by a concealed operator, who can readily follow the progress of the game by means of a system of target blocks which are vibrated by the impact of the bullet. The baseball field is placed in an upright position in the shooting gallery. The bases consist of openings or slots through which the operator signals the various positions of the "player."



The baseball rifle target. The operator is shown in the rear

The pantograph device which moves the cardboard ball and signals

The ball is a circular piece of cardboard held in position by a metallic ring fastened to a rod leading down and behind the board. By means of a pantograph arrangement (four light, rigid links joined together in parallelogram form) the operator from his position behind the board can move the ball as he wishes.

The target is located in the batter's position. It is the same shape and size as the ball, but instead of being in one piece it is divided into seven blocks, each mounted on a separate sleeve running through the board to which is attached the signal devices for the operator. The faces of the blocks toward which the marksman aims his gun are marked first base, second base, third base, right field, center field and home run.

To play the game the gun is aimed at the most desirable block—the home run block. The shot must not be fired until the operator has caused the cardboard ball to travel toward the catcher. The object is to puncture the ball as it passes over the batter's plate or target and hit the home run block. If the bullet strikes some other block grouped about the home run block, the operator scores first base or second base, according to the block which he succeeds in hitting.

Failure to hit the ball as it passes over the plate registers a strike. If the ball passes the catcher's position without being fired at, it is a "passed ball." By rearranging the target markings and signals a game of football, polo, lacrosse, cricket or pinochle may be played with the same apparatus.

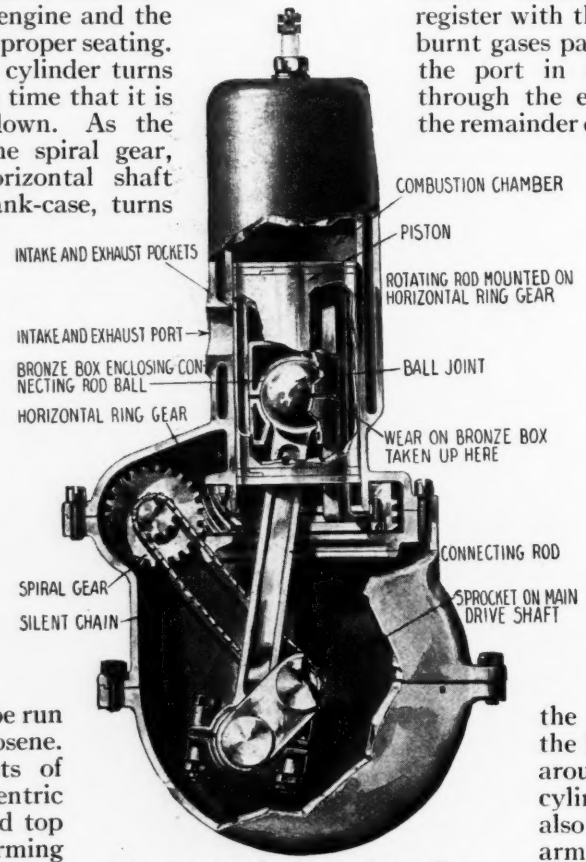
A River Which Keeps Warm by Its Own Power

ONE of the hydro-electric power plants of the far north, which uses river water to supply current for its electric gold dredges, has devised a novel scheme to make the river keep itself warm. Electric heating units have been sunk in the bed of the stream and the power generated by the falling water actually raises the temperature of the flowing water enough to prevent the river from freezing during the coldest weather. Thus the stopping of the work during the winter months is avoided.

New Valveless Four-Cycle Gasoline Motor

It is applicable for use in automobiles, motor-boats and stationary engines

TWO Grand Rapids engineers have perfected a valveless four-cycle engine designed to eliminate the grinding of the valves and seats of the ordinary poppet valve engine and the power loss due to improper seating. The piston of each cylinder turns around at the same time that it is moving up and down. As the engine operates, the spiral gear, mounted on a horizontal shaft enclosed in the crank-case, turns the horizontal ring gear meshed with it. Moving with this are the L-arm and the piston, the latter moving up and down on the arm. The reciprocating movement of each piston is secured while it is turning around by means of an ordinary connecting rod which also has a ball-and-socket joint at the top.



The absence of valves reduces vibration to a minimum and insures stability. All charges are of equal proportion

The motor may be run on gasoline or kerosene. The piston consists of two hollow concentric cylinders, the closed top of the outer one forming the head of the piston. The angular space between the two pistons is open at the top through a short segmental port in the head and at the bottom through a port in the piston wall.

By proportioning the spiral gear and the gear ring so that the piston makes one complete revolution to two revolutions of the motor shaft, the piston port is made to register with the intake port for the admission of the fuel gas. The latter passes up through the piston to the top of the cylinder. As the piston turns around, the intake is closed and remains closed while the piston is moving up and compressing the gas. It remains closed as the gas is exploded and as the piston is forced down. Before the piston gets to the bottom of its expansion stroke, its continued turning makes its port register with the exhaust port, the burnt gases passing down through the port in the head and out through the exhaust port during the remainder of that stroke and all of the next upward one. The cycle is repeated as the engine operates.

The combined circular and up-and-down movement of the cylinders is accomplished through the spiral gears mounted on the horizontal shaft enclosed in the crank-case on one side and driven off the main shaft by means of a silent chain. One spiral gear is employed for each piston, the gear meshing with the horizontal ring gear around the base of the cylinder. The ring gear also carries the L-shaped arm.

New Uses Suggested for the Rubber Sponge

RUBBER sponge is about the lightest solid body known. True, it is full of holes, but it is nevertheless watertight and very nearly gastight when molded into forms. For life preservers it is an ideal material. As an automobile tire filler it promises to transplant fillers which heat up or decompose. For this use it must be molded to fit the inside of the tubing. It has even been suggested as a clothing material for aeronauts.

A Practical Shotgun Sight for the Trap-Shooter

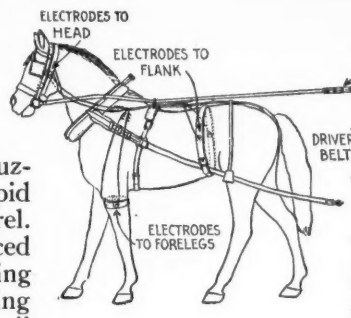
MOST shotgun sights are a delusion and a snare, for the reason that in shooting at a flying object, there is neither time nor tendency on the part of the shooter to see anything but the mark and a flash of the gun. There is no analogy between the shotgun and the rifle. Most inventors of shotgun sights fail to realize that.

However, any one sight that makes the muzzle of the gun more easily caught in the quick glimpse from gun to bird, is worth while. Many experienced sportsmen use a large and plain ivory bead at the muzzle, the better to define the muzzle on the mark in the rapid process of alining the barrel. A smaller ivory bead placed back along the rib and acting as rear sight is a good thing to check up one's "holding," in practice with the empty gun; but it is never seen in actual shooting at fast moving marks.

A. G. Flickinger, a Pacific Coast man with much trap-shooting experience, has patented and tried out in actual shooting, a front sight for single-barrel shotguns of repeating and other varieties. It is a practical shotgun front-sight, consisting of a ring to slip over the muzzle, with a bayonet form of catch to engage in the factory brass-bead front-sight.

This steel ring carries on it a ring-shaped bead of ivory or some such white colored material, easily and quickly picked up by the eye, and more easily seen than even the largest of the ordinary ivory beads mounted on the barrel rib at the muzzle.

The inventor of the device claims that the amateur using it will find his markmanship so much improved that very soon he will be justified in considering himself eligible to the title of expert shot in the ranks of the experienced trap-shooters.



The balky horse is shocked in the flanks to spur him on. A refusal to turn when desired is met by a shock on the head

To Cure a Balky Horse Just Press a Button

FROM out of the West comes the electric tamer of balky and runaway horses. Press a button and a fractious horse is brought to a standstill.

The essentials are a small shocking-coil and its battery. These may be carried under the carriage seat or in a belt strapped on the body of the driver. Electric wires run from the shocking-coil to four strap-keys on the harness reins. Other wires lead from these keys to various points on the horse's body.

If the horse gets balky and refuses to move, key number one is pressed. The two wires which lead from this key run to opposite points on the horse's flank. He gets an electric shock which will certainly start him. If he should refuse to turn when desired, one of two keys are closed to give him a shock on the proper side of his head. Should he start running away, the last key will stop him. Wires are run from this key to a belt fastened around the top of the left foreleg.

The steel ring sight with the bead of ivory or porcelain is slipped over the muzzle

Blow Up the Earth? Not with Dynamite

By Hudson Maxim

These wonderful facts about explosives are taken from a chapter in the author's recently published "Dynamite Stories." They indicate that to know all there is to know concerning even dynamite is to fear practically nothing.—EDITOR.

WHEN one of our big army or navy cannon is fired, the time which elapses from the instant of complete ignition of the powder charge to the instant that the projectile leaves the muzzle of the gun is about the fiftieth or the sixtieth of a second, and in that time the hard and horn-like smokeless powder material is burned through only about a sixteenth of an inch; hence the rate of combustion or rate of explosion of smokeless powder in a cannon is about four inches per second, while it has been ascertained by actual experiments that the rate of combustion or rate of explosion of dynamite and other high explosives is about four miles per second, so that the rate of consumption of smokeless powder, as compared to that of a high explosive, is as are four inches to four miles.

If a celestial giant should touch off a bomb immediately behind our earth, the earth would be thirty thousand miles away before the bomb exploded

As the time required for the projectile to be thrown from a twelve-inch cannon is only about the sixtieth of a second, sixty of these huge guns could be placed side by side and fired by electricity one after the other, while grandfather's clock is making but one tick.

Our ideas of duration are but relative. Great as is the speed of the detonative wave, yet the speed of the earth in its orbit is four times as great. If a celestial giant with a huge dynamite bomb the size of the earth itself were to approach the earth in its flight through space, and detonate the bomb immediately behind the earth, it would take half an hour for the bomb to explode; that is to say, it would take half an hour or thirty minutes for the explosive wave to pass through the eight thousand miles of its diameter. As the speed of the earth in its orbit is four times as great as that of the explosive wave, the earth would rush away, leaving the bomb about thirty thousand miles behind by the time it had completely exploded. If the interstellar ether were a high explosive mixture and were to be set off by the bomb, the earth would pass on clear around the sun, and while coming back about six months later, would meet the explosive wave still going. It would require nearly a year for such a detonative wave to reach our sun from the earth.

Can Our Earth Be Blown Up?

We frequently hear the theory advanced that planets and suns sometimes explode from pent-up forces within them, and that our earth might possibly blow up. Now, the force exerted by a high explosive is dependent entirely upon the pressure capable of being exerted by the gases liberated

by the explosion. The pressure exerted by the most powerful high explosives has been estimated to be about 500,000 pounds to the square inch. Consequently, were the whole molten interior of the earth to be replaced with dynamite and detonated, the explosion that would follow would not lift the earth's crust. The superincumbent weight of the earth's crust is greater than would be the pressure exerted by the dynamite.

When one of our big twelve-inch cannon is fired, the projectile, weighing a thousand pounds, has a muzzle energy, stated in mechanical terms, of about fifty thousand feet tons; that is to say, its energy is equal to fifty thousand tons falling from a height of one foot—energy enough to lift two 25,000-ton battleships to the height of one foot.

Waters Which Exert a Pressure as Great as Dynamite

Mother Earth is the greatest of all explosive manufacturers. Water seeping down into the earth's crust and trapped in large quantities in the neighborhood of volcanoes sometimes becomes heated to high incandescence—heated until it is no longer water or steam, but mingled oxygen and hydrogen, far above the temperature of their dissociation—under a pressure so great that they occupy a space no larger than did the original water; consequently the entrapped waters exert a pressure as great as the strongest dynamite.

The most notable volcanic explosion that ever occurred in historic time was when that old extinct volcano, Krakatoa, in the straits of Sunda, that had been sleeping for thousands of years, was literally blown into the sky by the pressure of the pent-up gases beneath it.

This great eruption occurred in 1883. More than sixty thousand persons were killed. The captain of a tramp steamer saw a very strange disturbance in the sea, in the direction of the old mountain. Taking his glass he saw a perfect Niagara of water pouring into an enormous fissure that had opened in the earth. He was struck with consternation, and rightly imagining that something very serious was likely soon to happen he put on all steam to escape, and luckily he had reached a point which enabled him to survive the effects of the awful blast when it came.

The Fissure Which Swallowed a Niagara

The vast mass of water which had tumbled into the bowels of the earth was immediately trapped by the closing of the great fissure down which it had poured. The water was quickly converted by the intense heat into a veritable high explosive, with the result that the massive mountain was literally blown bodily skyward, and fell in huge fragments into the surrounding sea. The shock was so great that it was felt clear through the earth, and an immense tidal wave was set going which encircled the earth. The opposing portions of the great wave, meeting in the lower Atlantic, flowed up even to the coast of France. An atmospheric wave passed around the earth three times. The amount of volcanic mud that was discharged from the mountain during the eruption was more than the muddy Mississippi discharges into the Gulf of Mexico in two hundred years.

Sixty twelve-inch naval guns, loaded with several hundred pounds of explosive each, could be fired by electricity one after the other while grandfather's clock is making one tick

Coaxing Birds to Your Garden

They are easily persuaded to accept your hospitality and protect your crops from insects

By George M. Oaks

Bird-houses made by the members of a manual training class in Omaha, Nebraska. The houses with the small holes are for wrens; the others are suitable for bluebirds, nuthatches, chickadees or fly catchers

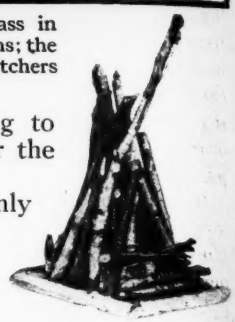
A swinging wren-house of bark

A COUNTRY house without birds is almost like a garden without flowers.

The economic worth of birds about the premises cannot be overestimated. During the breeding period, they work early and late to obtain sufficient food for their nestlings, and their food consists mainly of insects harmful to the farmers.

It is not hard to get acquainted with birds; they are not half so diffident as many humans. A certain amount of coaxing will sweep away any conventionalities which might exist and the birds can be induced to eat from the window sill, and later from the hand.

Place a generous supply of cheese crumbs and walnut meats on the palm of the hand and hold it flat on the ground. Keep perfectly still and wait. After a while a bold young robin will spy this restaurant. Goaded on by his rapacious appetite—for birds are reputed to be always hungry—he will finally risk everything to satisfy his longing for the tempting viands.



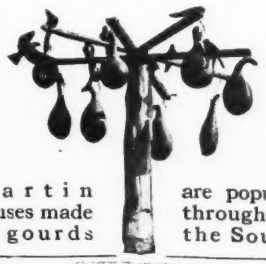
A rustic stationary house for wrens

A few years ago, only four species of birds were commonly regarded as house birds—the wren, the bluebird, the tree swallow and the purple martin. Now many species (nuthatches, titmice, flycatchers, tree swallows, chickadees, flickers, and red-headed and golden-fronted woodpeckers) which would not ordinarily be expected to avail themselves of artificial homes, are willing occupants of properly-built houses.

Another wren house. The tiny wren is very useful to the farmer, nine-tenths of its food being insects

Easiest to please are Mr. and Mrs. Wren. They will accept your hospitality whether the accommodations consist of an elaborate little mansion with cupolas and arched windows, or simply a discarded tomato can, suspended by a piece of picture wire. You can bring gladness to their hearts by simply cutting a hole the size of a quarter in the bottom of a tin can, plugging the other end with a disk of wood, and fastening the tiny house on a convenient

veranda post, on the bedroom window sill, or in the fork of a tree. But place it beyond the reach of cats, and do not forget that by making the hole small, you will prevent large birds from entering the wrens' home. Place it in the shade. Otherwise the tin will be heated by the sun. Wrens are so fond of hauling sticks and twigs to their nesting sites that a tall, slender little house, with the entrance well above the middle of the front, seems to suit them best. They will also colonize if a house with many nests is provided for them.



Martin houses made of gourds are popular throughout the South

In southern states, the use of gourds is very common. The entrance is made in the side, and a drain-hole is left in the bottom. A neat house for wrens can be made from a cigar box. All wren houses should be placed in early May, but since wrens rear two broods, they will often take possession of a box put out late in June.

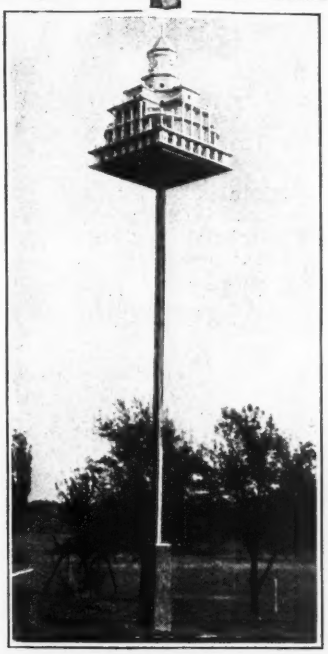
Regardless of the material used, the house should be all built and in position a fortnight before the bride and groom arrive from their honeymoon. Mr. Wren's first act will be to fly away in search of an old cast-off snake skin. He will bring home a bit of it for a sort of hearthstone relic—perhaps a protective measure, since it is said that snakes will never go near a discarded skin.

Other birds have their crotchets too. The red-breasted nuthatch, for instance, after he has excavated his wooden house in some old dead stump, invariably collects a lot of soft pitch and makes a sticky ring around his doorway.

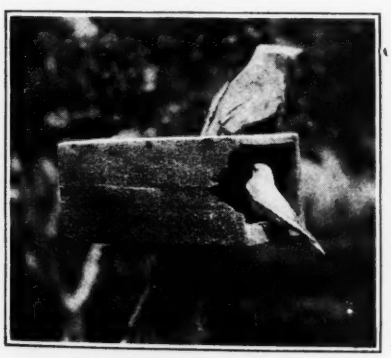
Birds are as particular about their perches as you and I are about our beds. If no bird will enter the bird house that you have built, look to the little perch at the doorway. Did you unwittingly place it on the left side? All birds are right-handed. Be sure the perch is on the right, and then the bird can hop into the nest in the "right" way.

The largest and most beautiful of the swallow tribe, the purple martin, is also one of the friendliest and most useful to the farmer. It comes north in the spring. Sometimes it arrives so early that the cozy little home provided for it becomes a tomb when a sleet storm sweeps all insect food from the air.

Martins are so chummy that they always seem to be having a family reunion. By all means, provide a large eighteen or twenty-family apartment house, with all modern conveniences, and your efforts will be generously rewarded. They delight in a house of many rooms, especially if it is mounted on a pole at least



A colony house for martins located on the Henry Ford Farms, Dearborn, Mich. The iron pipe, used as a pole, guards against prying cats and squirrels. Martins are fond of large houses suitable for many families. They like a house mounted on a pole at least fifteen feet high and as much as fifty feet away from the nearest tree or building as a safety measure

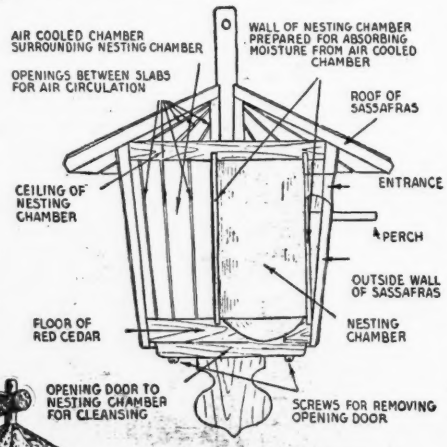


Bluebirds love weathered wood. This one is rearing her young in an old discarded mail box

A mountain bluebird feeding her fledglings in a pan of suet which someone has attached to a tree

fifteen feet high, and as much as fifty feet away from a tree or building. To comply with every whim, the house should also be located near some telegraph wires on which the birds can perch and gossip.

To outwit the martins' great enemy, the English sparrow, build the house with two gable rooms which connect inside in such a way that it is noticeable from the outside. Martins have a custom of sending a scout ahead. He always enters the topmost room first. If sparrows see him, they will make things so unpleasant for him that he will not care to return, and the whole martin tribe will travel elsewhere. But if the scout is able to escape through the opposite opening, he will hasten to call together all his followers, and, making a veritable "war drive," they will rout out the sparrows and take possession.

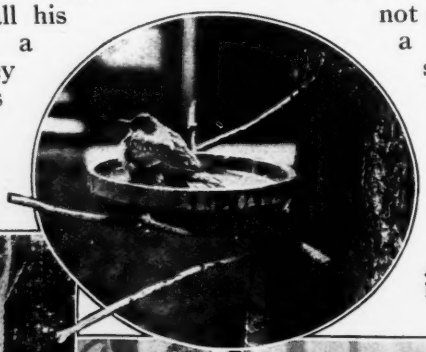

AIR COOLED CHAMBER SURROUNDING NESTING CHAMBER
WALL OF NESTING CHAMBER PREPARED FOR ABSORBING MOISTURE FROM AIR COOLED CHAMBER
OPENINGS BETWEEN SLABS FOR AIR CIRCULATION
ROOF OF SASSAFRAS
ENTRANCE
CEILING OF NESTING CHAMBER
PERCH
OUTSIDE WALL OF SASSAFRAS
FLOOR OF RED CEDAR
NESTING CHAMBER
OPENING DOOR TO NESTING CHAMBER FOR CLEANSING
SCREWS FOR REMOVING OPENING DOOR

A sanitary bird-house invented by Edwin H. Reiber. The nest cannot get overheated and yet admits no drafts. Note that the perch is on the right of the entrance, since birds are right-handed

Fruit growers and poultrymen can do no better than to attract martins. They are relentless in their pursuit of hawks, and tireless in cleaning fruit trees. Three-fourths of a martin's diet consists of wasps, bugs and beetles.

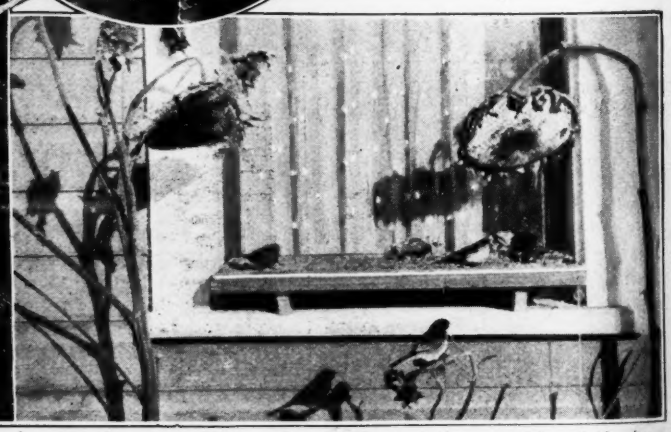
It will be impossible to discuss all the birds ready to accept invitations to make their homes near you, but we cannot pass by that little announcer of spring, the bluebird. Like the robin, phoebe and house wren, Mr. Bluebird is very domestic in his habits. He belongs to no clubs and always stays at home evenings.

Bluebirds usually seek out natural cavities in old apple trees or crannies in farm buildings. It is well to bear this in mind when fashioning a bluebird house. Remember the bluebird's love for old weathered wood and do not offend him by offering him a gaudy, freshly-painted, stiff little house which has no history or traditions. Instead, use some old boards that have felt the sun's expansive heat in summer, and the icy sleet



A young robin taking his morning plunge

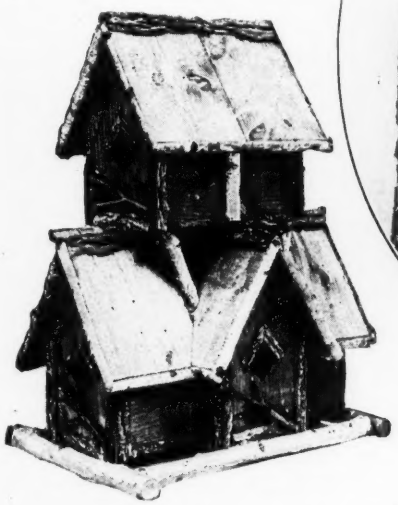
This lunch counter is always protected from the wind, being pivoted on its support



Sunflower seeds are the chief attraction at this window cafe. A house finch, gold finch and Oregon junco are the three very hungry and very appreciative patrons shown

of winter, to which the weather has imparted the grayness of age so pleasing to the eye.

Mrs. Bluebird always starts housekeeping by making a mat of grasses on the floor of her house. For the eggs, a depression is made back against the rear wall, apparently to keep the young as far away as possible from the paws of marauding squirrels or cats. She arranges the position of the eggs so that during the fourteen days of brooding she can watch for danger, and at the same time relieve her monotony by observing the doings of the outside world.



Mr. Nuthatch entering his open-air dining-room

At left: A rustic house for six families of martins

Different birds require different kinds of houses. The best material is wood. Almost any sort of lumber may be used, but birds take most readily to that which has been weathered outdoors. White pine and cypress are easy to handle, and do not warp or check. It is often desirable to leave the bark on the outside. Entrance holes should be countersunk from the outside. Sloping the floor, or boring a small hole in the middle directly under the nest, provides drainage.

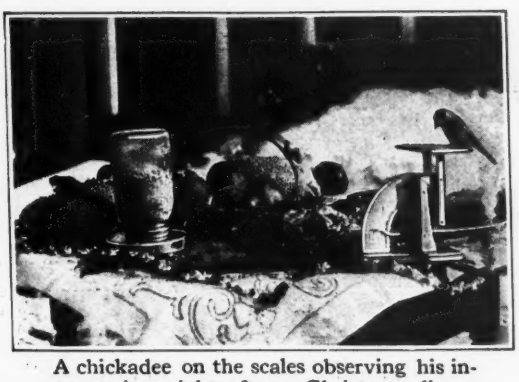
A coat of paint of a mild green or gray shade is desirable. If the house is placed conspicuously, it may be painted white or some light shade.

All houses must be easy to open for cleaning. Each spring, before the birds return from the South, all filth and litter should be flushed out with the garden hose. A little sulphur scattered about a house is an effective remedy for undesirable parasites.

Proper ventilation can be obtained by means of a row of small holes bored just beneath the eaves. Never have a ventilating hole lower than the entrance, since this gives rise to drafts.

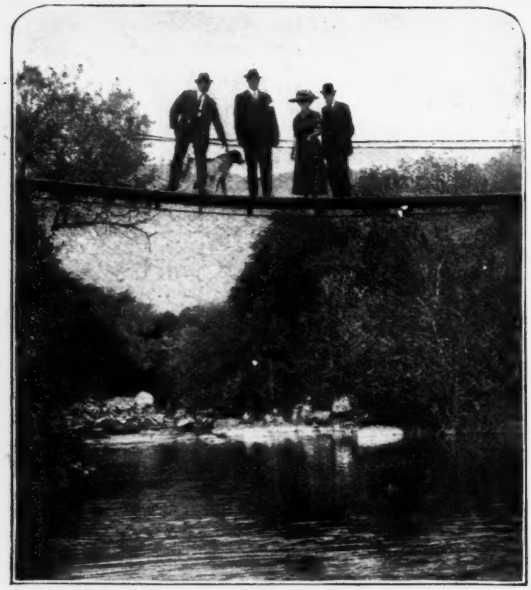
There is no wedding gift so acceptable to a young bird couple as a drinking fountain and bath. It is hard to realize the difficulty often experienced by birds in obtaining water. A refreshing drink and splash in a shady retreat is the bird's greatest delight. But mind that you do not choose a spot near dense shrubbery or other objects behind which prowling cats may hide waiting to spring on the unsuspecting bathers.

The receptacle may be merely a shallow tray of wood or metal, but it should always be inconspicuous in color, and rough enough about the edges to afford a firm foothold. It must be shallow to prevent drowning. Cement and stone basins, mounted on pedestals, are pleasing additions to the lawn and are obtainable throughout the country. However, a low flaring crock, a galvanized pan, or a hollow log, seems to please the birds just as well.



A chickadee on the scales observing his increase in weight after a Christmas dinner

Birds must be protected from their enemies. It is easy enough to keep cats, squirrels, mice and rats away by a piece of tin encircling the tree. It is also well to isolate a birdhouse on a length of iron piping. Ants and other vermin can be kept out by sticky flypaper made of resin and castor oil.



Two steel cables anchored to trees on opposite banks form the only support of this bridge which spans a river fifty feet wide

How Springville Built a Bridge of Cables, Boards and Chicken Wire

WHEN the State refused to help them by providing a bridge across the Tule River near Springville, California, the residents decided to erect their own bridge, the one shown above.

The bridge spans fifty feet of river. It is suspended by two half-inch steel cables which are anchored to trees on the opposite banks. Strong pine planks are placed across the tops of these cables. Steel wiring and bolted steel clamps hold the planks securely in place. Between the planks, wooden boards are nailed to form a board-walk.

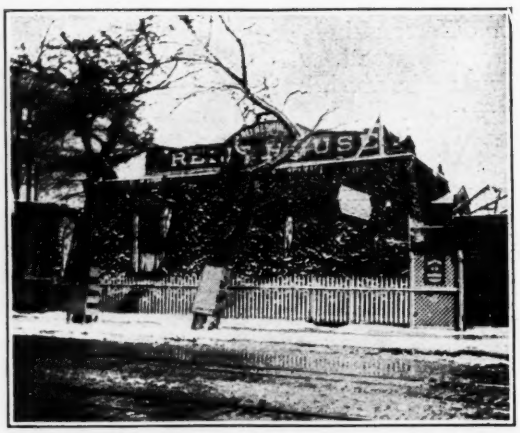
When the bridge was first used, nervous persons refused to walk across it because of its narrowness. Two light steel wires were then placed not three feet above the level of the foot-bridge. Ordinary chicken-coop netting was suspended from these to the sides of the bridge as railings.

Fabric Linings Take the Place of Wood and Steel in Braking Trains

IT is a surprising fact that ordinary fabric is such a superior friction material that it is replacing all other substances for braking trains. Cotton or asbestos brake-linings are better than wood because they can stand intense heat much better. Moreover, fabric linings can grip wet wheels more strongly than wooden brake-blocks can. The reason that iron blocks have given way to fabric linings is interesting. It has been proved that in the New York subway, three quarters of a ton of iron dust is scraped from the train wheels by the metal blocks each month for every mile of traveling. This dust not only short circuits the electrical signaling apparatus and interferes with the dispatching of the trains, but by mixing with the oil thrown from the train motors it produces a highly inflammable compound. The great danger from such accumulations is entirely done away with when fabric brake-linings are used.

A House That Arose Out of the Ashes of Chicago's Great Fire

THERE are houses of brick and stone, houses of grass and even houses of glass, we are told, but perhaps the oddest of all as to history is the Relic House in Chicago, Ill., which is built entirely of debris gathered after the great fire of 1871. The house has been standing for forty-five years and serves not only as a reminder of the great disaster but as a restaurant and lunchroom as well.



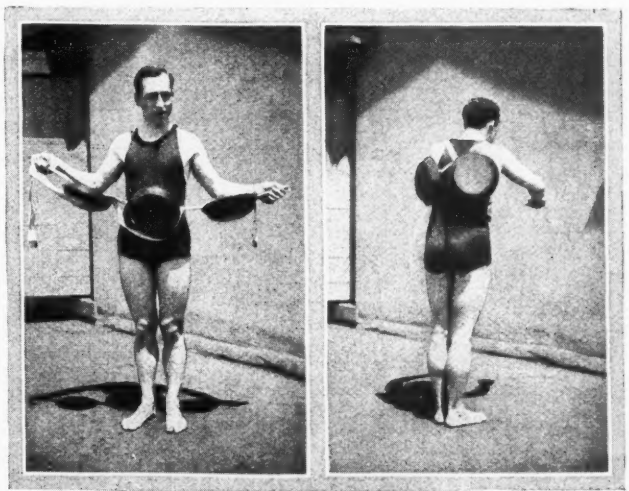
All the material used in the construction of this house was taken from rubbish heaps after the great fire. Bits of crockery decorate it

The usage to which this structure is put testifies to its attractiveness. In fact it was never intended to look otherwise than attractive, in spite of its origin. Old horseshoes, scraps of metal of every kind, and nails were melted down. Bits of broken crockery were employed as decorative material. All the wood necessary for the structure was easily obtainable from rubbish heaps. It is one story high.

FOR PRACTICAL WORKERS

A New Life-Preserver Made of Sheet Metal

METAL swimming plates have made their appearance in the field of life-preservers. These are called the safety-first buoyant swimming-plates and they consist of metal parts put together just like two tin pie-plates soldered with their faces joining, allowing the space between them as a dead air chamber. The advantage of these plates lies in the fact that they will not rot or crumble like a cork life-preserver. A properly applied paint prevents rusting, and they are always ready for use. They do not have to be inflated like the water wings which are used by some swimmers. There is no danger of leaks or punctures and the total weight of the appliance is about 3 lbs. The plates are not uncomfortable to wear and they allow a free arm movement to the swimmer. Three of the plates are joined together with a web band having a shoulder strap which buckles about the body under the arms, with two plates on the back and one on the chest. Small wire loops make the joinings.



Adjusting the life-preservers made of metal plates

Using Straight Side Tires on Clincher Rims

CAREFUL application of tires is as necessary to good service as the selection of correct size for the load, or rims of the right design and regular measurement. Straight side tires are sometimes used on clincher rims, but in such instances filler beads should be fitted in the rim clinches to prevent the side walls of the tires from being chafed and gouged by them. To avoid, as much as possible, the tendency of straight side tires to lift up from the rims at the inner edges of the cables and thus permit a rolling action sideways, it is considered advisable to have more spread between the cables than is necessary with the beads of the clincher type. The use of straight side cases on clincher rims is therefore discouraged. If best results are to be expected from straight side tires they should be used only on straight side rims which are slightly wider at the base, and which permit of the necessary spread between cables. Consider these cautions, and your tires will last longer.

A Small Single-Cylinder Homemade Automobile

MINIATURE machines built like or to represent larger types are not rarities, by any means; but the one illustrated does a double duty in carrying the owner wherever he wants to travel. Its owner, a boy of 15 years, built the entire machine save the engine, which is one of the single cylinder motorcycle type. However, many manufacturers of ordinary automobiles do the same, all power plants being purchased from manufacturers in that special line.

The engine is the kind used to attach to a bicycle, two horsepower, geared two to one. The main frame is built of hardwood, 6 ft. long and 15 in. between the inside surfaces of the side pieces. The wheels were those used on a No. 3 auto-coaster. The drive is obtained by a belt from the engine pulley to one of the rear wheels. With this method of control it is possible to have various speeds without a troublesome lot of gears. This arrangement consists of an idler pulley operated with a ratchet lever and quadrant. The engine can be run free, and the tighter the idler is drawn the more speed is attained, up to the limit of the engine speed.

The front axle is made on the fifth wheel principle and is turned with a rope on the end of the steering-wheel shaft. While it is not necessary to follow out the exact dimensions and style of this car, it furnishes the idea, and enough details are given so that a clever amateur can construct a similar car that will produce as good results. Such a little car can be made to more closely represent a large car if sheet metal is used instead of wood for the hood. The sides can also be made up of sheet metal and a rear covering put on

Ready for the start in his travels about the city and country

With every car owner sometroubles will arise and it becomes necessary to make adjustments or clean the spark plugs before making a long run in the country or in keeping the machine in good repair

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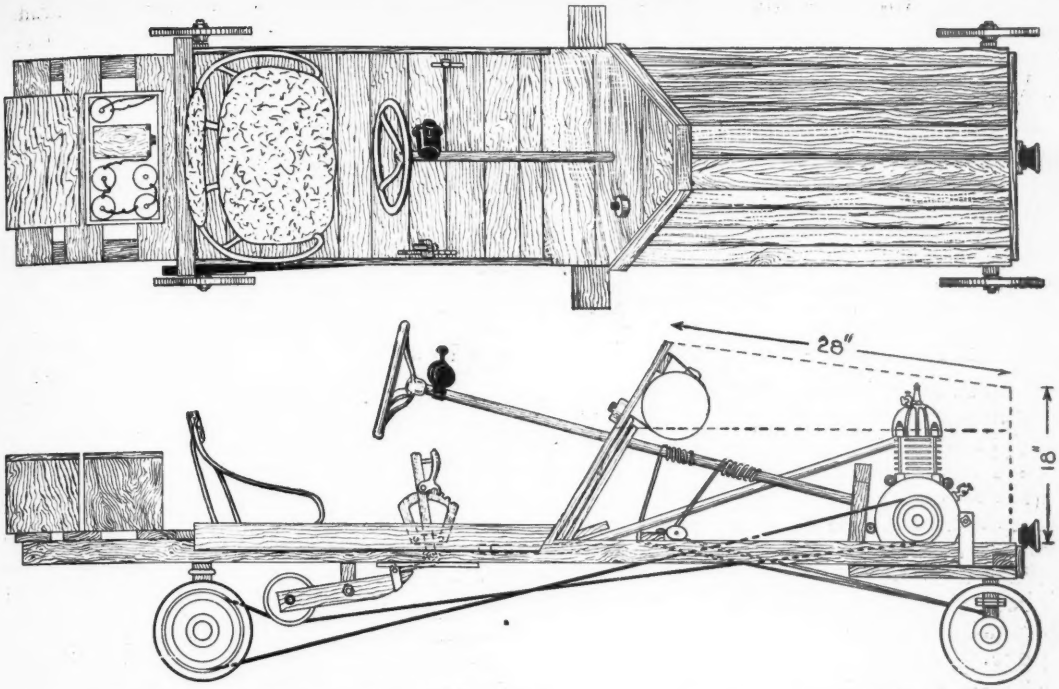


A rectangular frame is built up and a board bottom put in; then the engine is mounted in the front part and covered with a wood hood, the rear end of the chassis having the seat and battery boxes

over the battery boxes. The adjusting of the sheet metal is not difficult if the lines are kept straight and no sags or depressions are allowed to form. It is only necessary to build a light frame over which the metal is bent and fastened with nails or wood screws. Because the sides of the frame are low there is no need of doors for entering the car. The seat may be raised somewhat and upholstered to add to the appearance of the car. When the metal covered chassis is painted and striped up the effect is very neat.—CLEAGE FIELD.

An After-Dinner Trick with a Table Fork

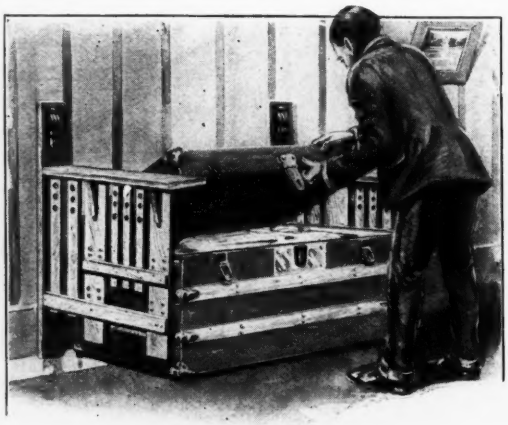
THIS makes a clever after dinner trick, the requisites for which are always at hand—a silver fork and a glass of water. A glass of tea will suffice and is a good substitute for the glass of water; in fact any glass containing a liquid will do. The fork is taken up and held in the left hand, as shown in the illustration. A glass of water is placed 2 ft. away towards the center of the table. With the thumb and second finger of the right hand pinch together the prongs of the fork, using the nails on the extreme tip ends and pulling the hand away quickly. This will cause the prongs to vibrate and produce sound-waves. After pinching the fork-prongs and producing the sound-waves the right hand continues toward the glass of water where the feint is made of throwing the sound into the glass of water. Strange to say the sound will seem to enter the glass and distinctly repeat itself. Allow someone to try it and they will fail. Here is the secret. Hold the fork in the left hand with the handle about 1 in. from the table top. At the moment the feint is made of throwing the sound allow the handle of the fork to touch the table. This produces the desired effect as the sound vibrates through the table into the glass. No one will observe the resting of the fork handle on the table as all attention is diverted towards the glass. A trial will convince a person that the majority of onlookers actually believe the sound is picked off the fork and thrown into the glass.—CLARENCE T. HUBBARD.

Pinching the fork prongs together to induce the vibrations

Using Fancy Wood Arms to Disguise a Trunk

WHILE in attendance at a military school it was necessary for me to keep a trunk in my room. The trunk I had spoiled the appearance of the room and I decided to make a set of ends or arms to change its appearance and make it useful as a seat. Afterwards I brought the arms home and still use them in the same capacity.

The arms are fastened to the trunk in such a manner that they do not interfere with the raising of the lid. Two blocks, about 5 in. square, are used for the purpose. These are secured to the trunk walls with screws. Screws are also used to fasten the ends to the blocks. The parts for both ends are fastened together with screws to facilitate taking them apart to pack for shipment.

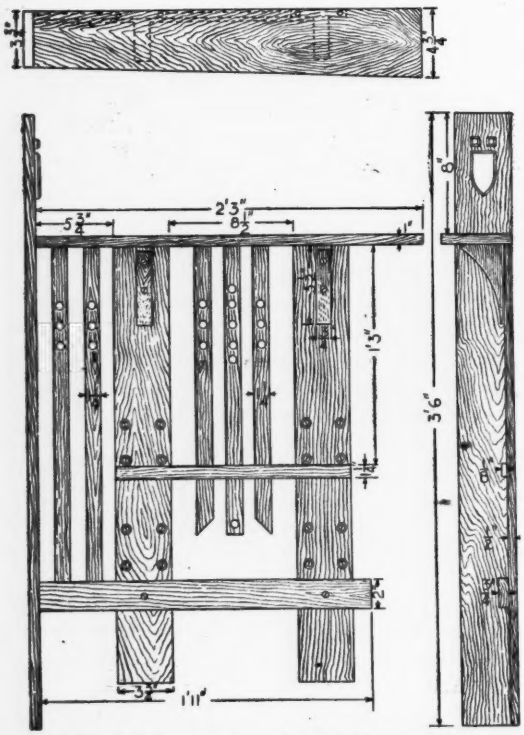


Ends built to represent chair arms and attached to a trunk to make a comfortable seat

As the trunk had to be kept away from the wall so that the cover could be raised, it was necessary to use a strip of wood the length of the trunk and about 4 in. wide, fastened with hinges to the back of the cover near the upper edge. This folds back on the cover when it is raised.

After the parts are cut out and planed, they are smoothed with fine sandpaper and finished to match other furniture or as desired.

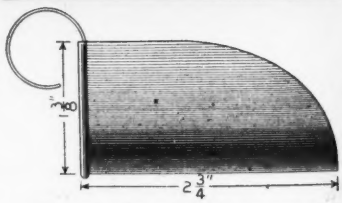
A pad is used for the seat, which can be made of burlap, leather or cloth, stuffed with cotton or other suitable material. There is no back to the seat, but the wall answers the purpose, and pillows may be used to make it comfortable, the same as for a divan.—ALFRED L. THELIN, JR.



Details of the trunk ends which may be cut from oak or soft wood and suitably stained

Salt Cellar Filler Made from an Oblong Can

SALT shakers are sometimes difficult to fill quickly with the usual filler—a small sized spoon. The illustration shows how a filler can be readily cut from an old tobacco can that is oblong in shape. The bottom is cut free and bent over into a loop, forming a very convenient thumb handle. The device will hold enough to fill one ordinary salt cellar.—F. W. BENTLEY.

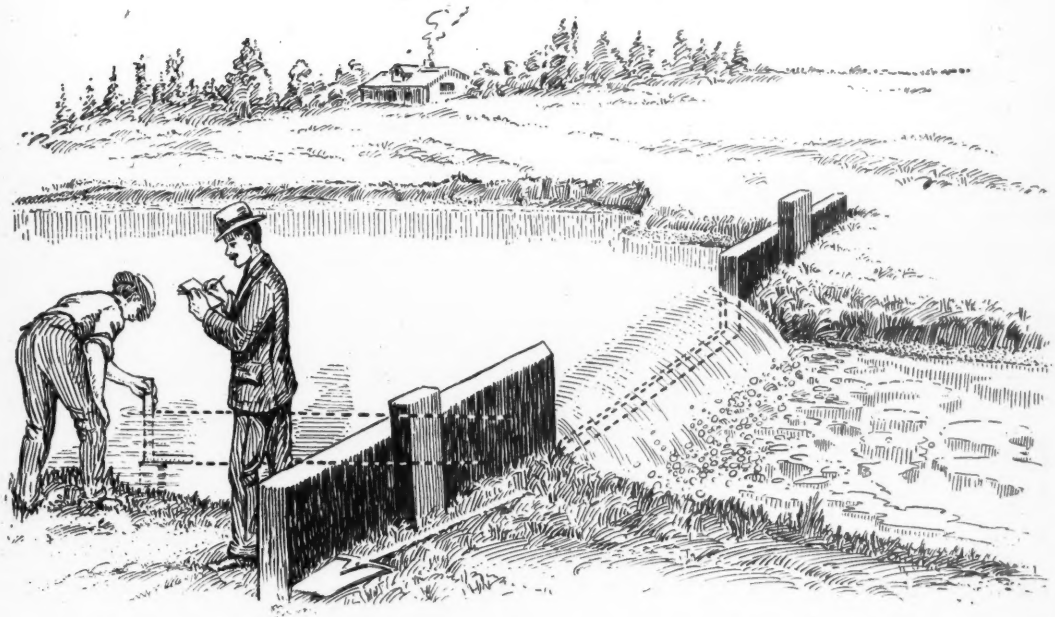


The can is cut with rounded edges in the shape of a scoop

Water Power From Small Streams

How you may estimate fairly accurately the capabilities of any stream

By H. B. Richmond



"THE very stream to run my lighting generator!" How many times have you thought that, when unexpectedly you came upon a little stream in the woods? But have you really any idea of just how much power can be obtained from a stream? Let us consider the situation, so that the next time you see a stream you will be able to estimate instead of speculate how much work it is capable of doing.

We will not bother about the refinements of stream gaging, or the intricacies of the design of turbine blades. Just enough of the fundamental principles to enable us to arrive at the desired result will be sufficient. That result is power, and the two items which make it up are the quantity of water flowing and the distance it falls. Quantity is measured in gallons per second, cubic feet per second, or other convenient units. The distance through which the water falls is known as the head and is measured in feet. Power may then be said to be the product of the quantity Q by the head H. If we accept the cubic foot per second as the measure for Q, the foot as our measure for H, and the horsepower as our measure for power we have the equation $P=\frac{QH}{8.8}$. This assumes that all the water power may be converted into work, which unfortunately is not true. In large installations it is not uncommon to utilize 80 per cent of the water, but for small streams it would not be wise for us to count on much over one-half. Taking allowance for this factor our equation would become, say $P=\frac{QH}{15}$.

Now all this is very fine if we know Q and H. Fortunately it is not very difficult to get an estimate of these quantities. If the water is coming over a single fall it is not at all hard to estimate or to actually measure the height in feet. If there are a series of falls to be utilized the sum of the heights of the several falls would be the height to use. This, of course, implies that the stream would be dammed at the last fall so that the water would back up to the level of the first fall, or that the dam would be placed at the first fall and then the stream carried on a level through a penstock to a point above the last fall.

It is not such an easy matter to determine the quantity of water flowing. A very simple way to get an estimate is to drop a small piece of wood in the stream a little distance above the falls and note the speed with which it is carried down the stream. I dropped a chip in a little woodland

stream and found that in one minute the chip moved 24 ft. down the stream. At this point the stream had an average width of 12 ft., and an average depth of 3 ft. I then estimated that Q in cubic feet per second would be the width of the stream multiplied by the depth and by the speed of the chip in feet per second, which is $12\times3\times24/60$ or 14.4 cubic feet per second.

Because of rapids or other influences, such as great irregularities in the shape of the stream, it is not always possible to determine Q by this method. A satisfactory way is to consider the falls as a weir. To make our proposition general we will say

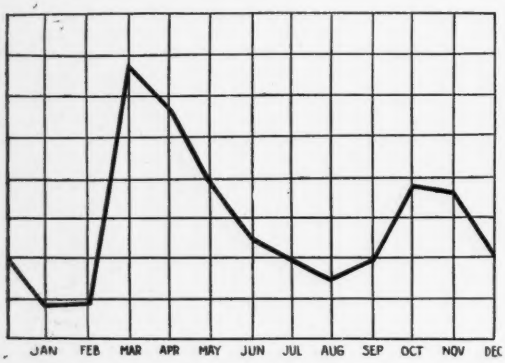


Chart showing the monthly variations in cubic feet per second for a period of one year

that the width of the stream as it goes over the falls is W feet and that the depth of the water as it flows over the edge or *crest* of the falls is C inches. It may then be shown that the quantity of water flowing over the falls in one second is $WC\,5\sqrt{c}/15$ cubic feet. Attention is called to the fact that the denominator 15 is the same as in the expression for horsepower developed. Care should be taken to get the total height C, as the depth of the water at the very edge of the falls is apt to be a little under the true depth.

The stream which we gaged by the chip method has in it a fall 12 ft. wide and the water has a depth of 7 in. as it flows over the edge. From the formula just given Q would be $12\times7\times\sqrt{7}/15$ which is 14.8 cubic feet per second, or approximately the same result which was obtained by the chip method.

The total height of the fall is 14 ft. so that the horsepower developed would be $QH/15$ or $14\times8\times14/15$ which is 1.4, or just slightly under one and one-half horsepower.

Remembering that one horsepower is 746 watts and that the efficiency of a generator of this small size would not be over 70 per cent, it will be seen that about 750 watts power would be available for use. This amount of power would light eighteen forty-watt tungsten lamps, which is all that would be required in an average house.

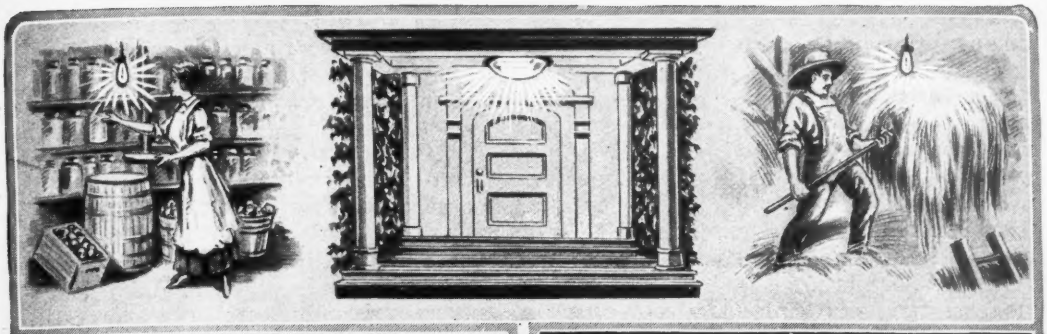
There is one other point to be considered and that is the constancy of flow. The flow of streams varies greatly over different periods of the year, as well as from year to year. An illustration of this is shown in the accompanying diagram which is a plot showing the average flow per month, in cubic feet per second, taken over a period of one year. Such a curve is called a hydrograph. The hydrograph for this stream shows that the month having the greatest flow was March and that the month of minimum flow was January.

In an actual installation the question of pondage, or water-storage is an important one. By building a large pond, or by using natural basins it is possible to conserve the water so that it will be used only as required. This would mean a greater supply and consequently more power when it was actually needed. Waterpower developments include many questions of this sort but they are all outside of the scope of this article. The principal point to be remembered here is that horsepower is cubic feet per second multiplied by the head in feet divided by 15, $P=QH/15$.

The installation shown in the illustrations is that of a power plant on a very small stream where it was not convenient to use a dam to store up the water for the power. The use of storage-batteries gave the same result. The water wheel is run all day long, generating all the power the stream affords and using that power to charge the storage-batteries, which were only used at night, except in the fruit storage bins where light was needed at any time.

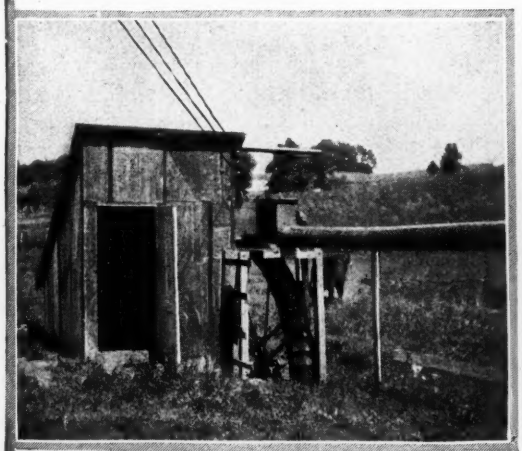
The battery consists of 16 cells, 80 amperes. The switchboard carries an ampere-hour meter that shows the condition of the battery; also an ammeter, which shows if more or less current is being used than is being generated; and an automatic switch which prevents the system from damage due to disturbances such as short circuits, lightning, etc. The outside wiring is carried on poles from the generator-house to the switchboard and from there to the various buildings that are lighted by the plant—residence, fruit storage building, cooperage shed, barn, carriage house and garage—six in all.

A Mere Tile Drain Supplies Water Power

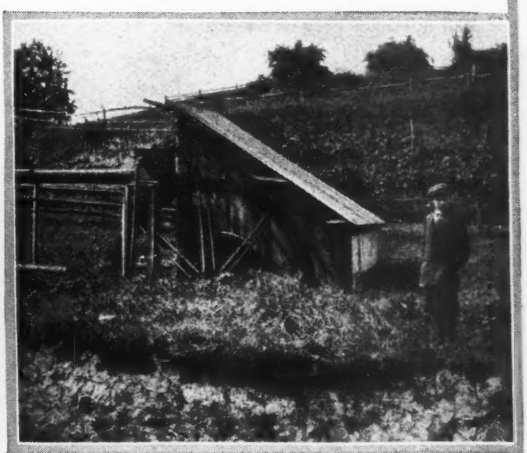


The tile opening in the ground from which the stream was first guided. As it was small in size and the ground quite level a dam of any size could not be used for storing the water, consequently the fall had to be obtained through a flume

The stream in this particular instance started from a mere puddle of water, where a slight obstruction was placed to guide it into the flume that was carried on trestles to the power house at some distance down the slope and near a ditch



Where the flume ended at the power house an automatic feed arrangement was attached over the water wheel so that only a certain average amount of water was allowed to spill on the bucket



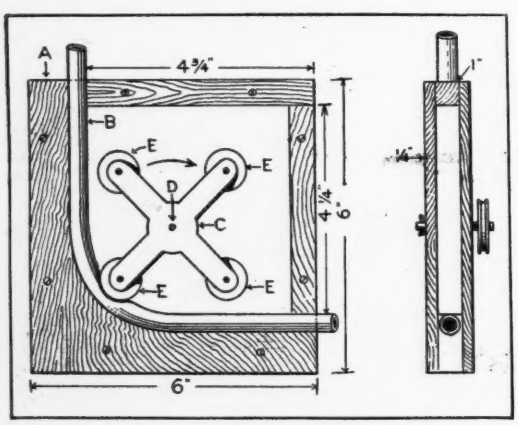
Within the house the drive wheels and dynamo together with the switchboard and storage-battery were placed. The discharge of water was run through a pipe into the ditch beside the power house

It is necessary to select the proper style of wheel for the fall of water. In this case, due to the small amount of water and head, it was advisable to use an overshot wheel. Where a stream has a greater head or volume of water a turbine wheel would be much better. The water is run into a pipe which terminates in a nozzle, and as the water spurts out at a high velocity the force is brought against cups on the wheel, making it turn and generating the power.

In the installation shown, a flume was made of 2-in. white pine stove pipe, with an internal diameter of 6 in. and the outside 10 in. This conveys the water from the ditch at the head over a distance of 250 ft. to the wheel. The flume is supported on wood frames. A steel gate for regulating the flow of water is located at the end of the flume just above the wheel. The gate is regulated at the wheel and one setting was found to be sufficient at all times, the head being about 14 ft. The wheel runs at about 9 revolutions per minute and the dynamo is driven at a speed of 900 through a gearing to a countershaft.

A Small Rotary Pump of Novel Construction

A SMALL rotary pump is very useful in a laboratory or for pumping liquids in window-displays. The one illustrated is of unusual and simple construction. It is very efficient and can be run with a small battery-motor. The casing of the pump is made of wood. The materials required are two pieces 6 in. square and ¼ in. thick, one piece 4¾ in. long and 1 in. square, one piece 4¼ in. long and 1 in. square and a piece cut like the one shown at *A*, which is curved along the inside edge to receive the rubber hose, *B*, that is of ⅜-in. stock.

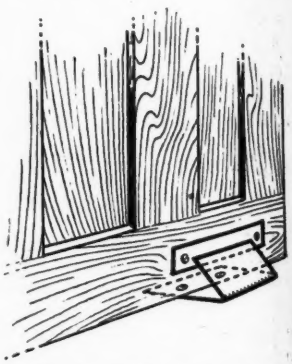


The rollers turning on the hose press it flat and force the water through it

From sheet metal, cut out two pieces as shown at *C* and solder them to the shaft *D*, 7/16 in. apart. At the ends of each pair of arms, rollers ¾ in. in diameter are pinioned as shown at *E*. These rollers should be made of hardwood with their edges slightly rounded to prevent them from cutting the rubber of the hose. The operation of the pump is apparent from the illustration.—E. R. THOMAS.

A Sheet Metal Door-Stop for Swinging Doors

A DOOR-STOP especially adapted for double and single swing doors can be quickly made of sheet brass, as shown in the illustration. To make one stop it will require a piece of brass 8 in. long and about 1½ in. wide. This is cut in two pieces, one piece being 5 in. and the other 3 in. long. Bend 2 in. of the longer piece back to form an angle as shown. Drill or punch two holes in the longer end for screws to fasten it to the floor. Make two similar holes, one in each end of the short piece, and fasten it to the door as a bumper-plate for the end of the stop. When the door is opened it is automatically held in place. A slight pressure of the foot will immediately release it.—JENNIE E. MCCOY.



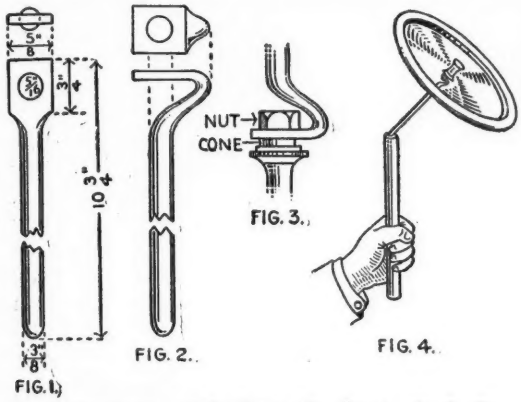
Sheet metal stop and bumper on door rail

A Simple Solution for Cleaning Straw Hats

STRAW hats can be cleaned with the following mixture: 83 Barium superoxhydrate; 17 sodium disulphite; 88 borax powder. To prevent the hat from becoming hard afterwards, dip it in a solution of glycerine and water (about 10 per cent) or wash it with peroxide of hydrogen. The mixture is applied with a small stiff scrubbing brush or a large tooth brush until the straw is bright.—C. F. OURSLER.

Making a Model Gyroscope from a Wire Spoke Wheel

EVERYONE knows that a top will not balance on its peg unless it is spinning; but few people understand what makes the top spin, or that in this simple toy lies the secret of the gyroscope, which is being



A gyroscope made from the front wheel of a bicycle, and the manner of spinning it

widely applied for steadying vessels, torpedoes, air-ships and mono-rail trains. With simple materials, anyone can make a gyroscope that will show many strange tricks of balancing.

The first thing required is a bicycle wheel, preferably a front wheel. If the tire is good, remove the valve plunger and pump the tire full of water. Then replace the plunger and pump in air until the tire is hard. If the tire is an old one, cut a hole in it and fill it with fine sand, covering the hole by winding it with tape. The object is to make the outer edge of the wheel as heavy as possible and keep the inner part as light as possible. If the wheel has no tire, and an old one cannot be procured, wind the rim with iron wire and cover the wire with tape, so that there will be no sharp edges to catch in the clothes.

Procure a piece of round iron, Fig. 1, 3/8-in. in diameter by 10 in. long and heat it red-hot; then flatten 3/4 in. of one end on an anvil. After making the end flat the length will be extended 3/4 in. Bore a hole 5/16 in. in diameter through the center of this flattened end, then bend the end to the shape shown in Fig. 2. The hole must come directly over the straight part of the rod, as shown by the dotted lines, and the bend must be sharp so that the nut will set firmly against a flat surface. To make sure of this, after the hole is bored and the iron heated almost white-hot on the end, dip about 3/4 in. of it into cold water. This will remove any tendency of the iron to bend in the vicinity of the hole.

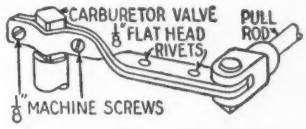
Remove the outer, six-sided nut, from one side of the axle on the hub of the bicycle wheel and screw the rod into position as shown in Fig. 3. Screw the nut back until it holds the rod firmly. On the other side of the axle, without removing the outer nut, tighten or loosen, as the case may be, the inner nut or cone, so that the wheel will turn smoothly on its ball bearings. Then screw the outer nut against the cone so that it acts as a lock-nut to keep the cones in adjustment.

The gyroscope model is now complete with the exception of a spinning stick. A piece of broomstick 1 ft. long is just right. In one end of it bore a 1/2-in. hole 1/4-in. deep. Bevel the edges of the hole with a jack-knife, and round them nicely with sandpaper. Hold the wheel by firmly grasping the iron rod, and with the stick set it into rapid motion; then raise it to a position nearly upright and support the rod either with the stick, as shown in Fig. 4, or in the palm of the hand or with the finger-tip.

It may take some time to learn how to handle the gyroscope skilfully; in fact, I was kept busy chasing my first model about the backyard for some time until the knack of controlling it was acquired. There are numberless tricks that can be performed with this toy, and they will suggest themselves as the owner becomes more acquainted with it.—E. P. THORNTON.

Repairing a Broken Carburetor Lever on Automobile Engine

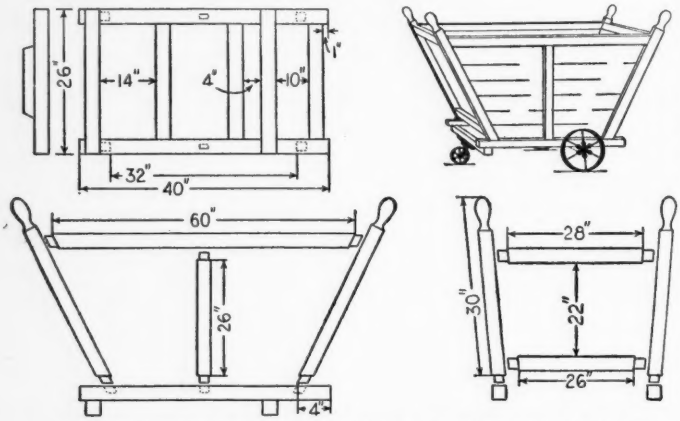
A BROKEN carburetor lever resulted in the temporary repair shown in the illustration. Two strips of steel 1/2 in. wide and 1/16 in. thick were annealed and bent in the shape shown. They were permanently riveted together at the pull-rod end and bolted at the other end where they clamped over the valve-stem head. Such a repair as this suggests a way to overcome a similar difficulty on the gasoline control line without waiting for an extra part.—ADOLPH KLEIN.



Two strips of metal clamped together to form piece for carburetor lever

A Light-Running Home-Made Feed Truck

ANY convenience to lighten the work of the farm chores is always welcome. The feeding of stock, where there is a large herd, is a tedious task which can be lightened considerably by the use of a feed truck. The illustration shows a home-made feed truck that holds 12 bushels. The list of materials is as follows:



A light-running truck used for hauling feed to large herds of stock where a feeding device is not a permanent fixture

2 Top side rails, 5 ft. 2 in. by 2 in. by 1½ in.
2 Middle uprights 28 in. by 2 in. by 1½ in.
4 End standards, 30 in. by 2 in. square.
2 Upper cross rails of ends, 30 in. by 2 in. by 1½ in.
2 Lower cross rails of ends, 26 in. by 2 in. by 1½ in.
2 Side sills, 40 in. by 2 in. square.
4 Floor joists, 26 in. by 2 in. square.
1 Axle bed, 26 in. by 2 in. square.
1 Front wheel bolster, 26 in. by 2 in. square.
1 Front wheel bolster, 12 in. by 2 in. square.

The frame is first built with mortise and tenon joints, according to the dimensions given, then the frame is covered on the inside with yellow pine boards that are ¾ in. thick, placed horizontally on the bottom and vertically on the sides and ends. The wheels were obtained from a junk dealer and they did service formerly on wheelbarrows. The axle was forged from a piece of shafting obtained at a local blacksmith shop. The axle was fastened under the frame just back of the center on the frame pieces. The forward wheel is a 5-in. swivel truck caster bought from a hardware dealer. This was placed on the two pieces cut for the front bolster. The truck is more easily trundled by hand when it is loaded than is the ordinary wheelbarrow.—T. H. LINTHICUM.

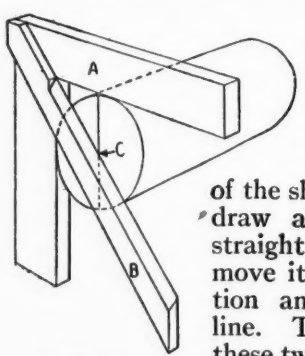
Writing a Name Under Shell on White of an Egg

HERE is a somewhat different egg trick, which is startling as well as mystifying. You hand a friend a hard boiled egg with the request that it be minutely examined. After he has satisfied himself that the egg is of the ordinary kind you ask him to print his name on the shell with a pencil or pen. Then tell him to break off the shell, and, much to his astonishment, he will discover his name plainly written on the white of the egg.

As you have probably guessed, there is a previous preparation, but it is very simple. Dissolve 1 oz. of alum in a half-pint of vinegar. Take a small pointed brush and outline your friend's name, or whatever you desire, on the shell of the egg. Let it dry thoroughly and then boil the egg for about 15 minutes. If these directions are carried out all tracings of the writing will have disappeared from the outside of the shell—but when the shell is cracked open it will plainly show on the white of the egg.

A Center Finder for Round Bars and Shafts

IN the illustration is shown a cheaply constructed center finder for round shafts. It consists of a steel square *A* made of ¼ by 1-in. mild steel stock carefully worked to a 90 deg. angle. Riveted to this is a beveled straight edge *B* at 45 deg. from either leg of the angle *A*. To use this device, place it across the end of the shaft as shown and draw a line along the straight edge *B*; then move it to another position and draw another line. The intersection of these two lines, as at *C*, is the center of the shaft. Of course, greater refinement and better wearing qualities may be obtained by hardening and grinding the various parts involved in the construction.—W. BURR BENNETT.



The center of a shaft or bar is easily found

Remodeling the Motorcycle

This article won the second cash prize of $15 in the Popular Science Monthly Motorcycle Contest

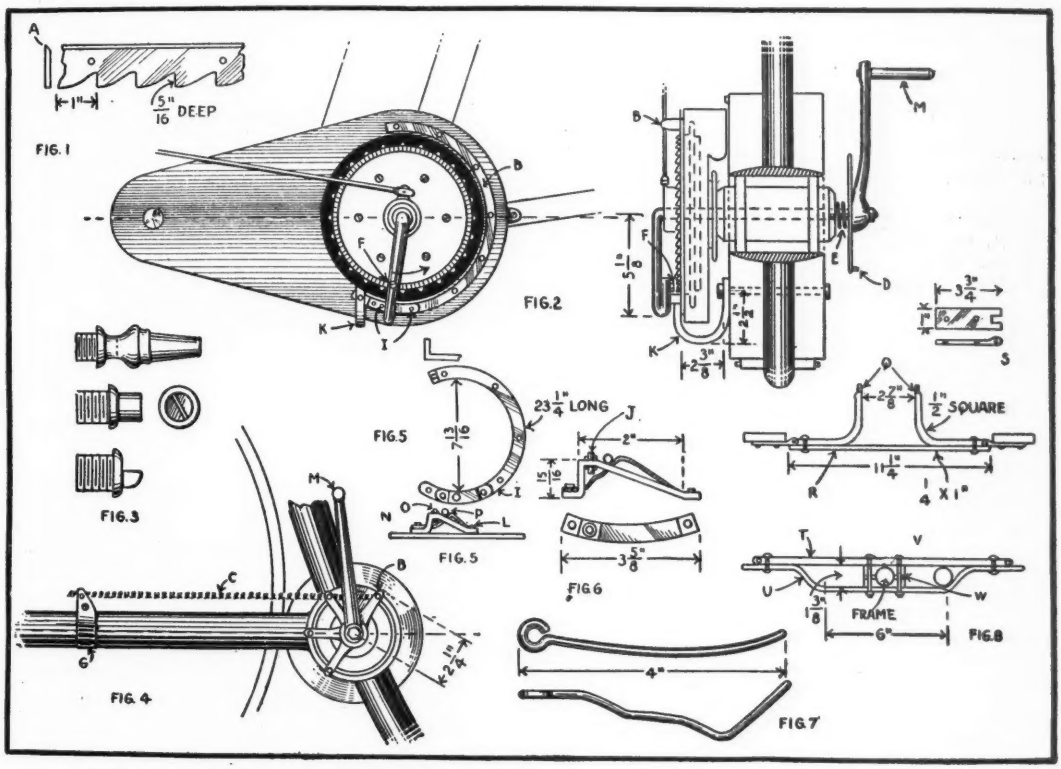
By Edwin C. Schurch

ALL modern motorcycles are equipped with the latest conveniences for starting the motor and for operating the brakes and clutch. This places the older machines, however good, in the antiquated class and makes them seem of little value compared with the newer machines. I did not care to sell my old machine at a very reduced price simply because it was not provided with modern equipment, as it served its purpose well. To bring it up-to-date in equipment I added a step or pedal starter, attached footboards, put on a foot-brake and a foot-operated clutch, and now it compares favorably with a new machine.

It is necessary to have projections on the clutch for engaging the catch on the pedal starter. These are applied in the form of a band, shown in Fig. 1, having teeth cut into one edge like a saw. The other edge of the band is beveled as at *A* to prevent catching on the chain. The band is made of a piece of metal about ⅛ in. thick and 1 in. wide with the length the same as the measurement of the circumference of the clutch-rim.

After cutting the teeth and beveling the edge it is riveted in place on the clutch-rim. The holes on the inside should be countersunk so that the rivets, when hammered down, will not catch on the clutch-plates. It is preferable to have the piece welded to form a complete band; but it is not necessary to do so as the rivets will hold it in place.

The left crank is then bent back so that the hole for the pedal is directly opposite the toothed band, as shown in Fig. 2. A



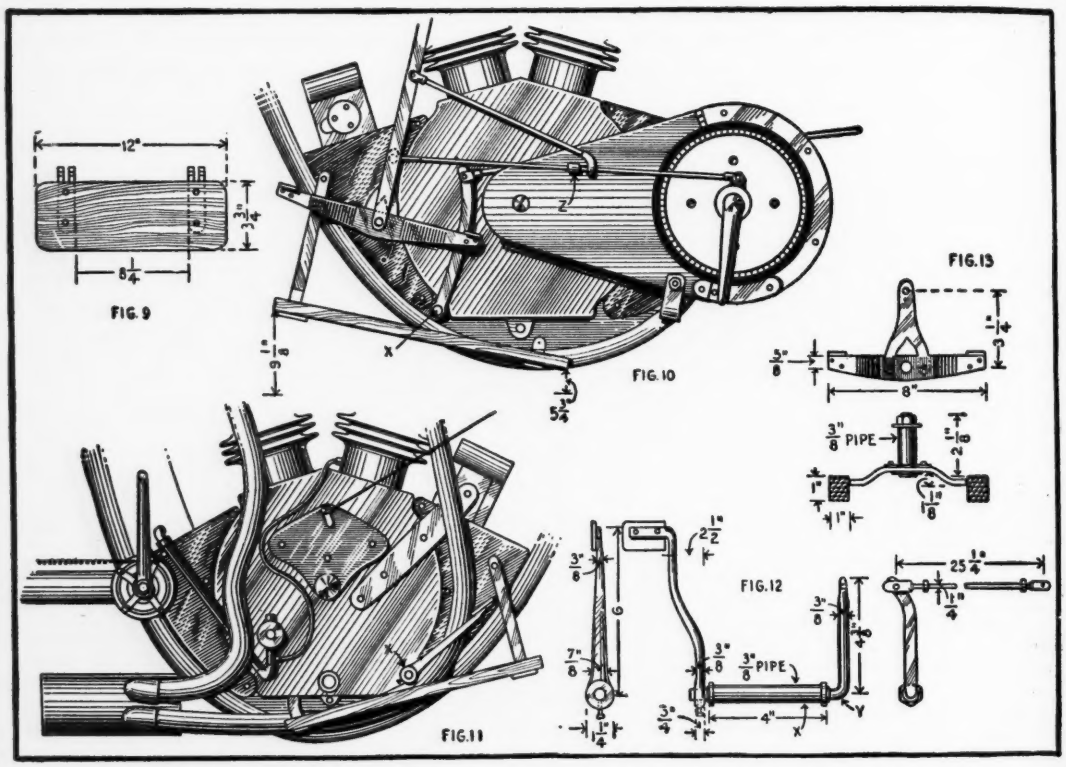
Details of the clutch band and the attachment of the crank so that a pin will turn the engine shaft by a push on the pedal pin. The construction of the footboard supports

pedal pin is ground as in Fig. 3—an old broken pin will do—and is turned into the bent crank-arm. This is intended to catch into the toothed band when starting the engine. The sprocket on the right crank-arm is removed and an old bicycle sprocket put in its place after its rim has been taken off and the unnecessary spokes cut out. A hole is drilled in the end of the spoke *B*, Fig. 4, for the spring *C*. The ends of the other spokes are fitted with the pins projecting ¾ in., as shown at *D*, Fig. 2.

The spring *E* is made of about No. 14-gage brass spring wire and its function is to pull the catch *F* against the toothed band when the starter pedal is pushed forward. It will take some experimenting to obtain the right adjustment for this spring so that it will perform its duty properly. The spring *C*, Fig. 4, is held to the frame with a clamp at *G*.

The stops for the left starter-arm are placed on the ends of a bar of metal made as follows: The piece is about 23¼ in. long, ¾ in. wide and ¼ in. thick. It is shaped as shown in Fig. 5. This metal piece is riveted to the chain guard so that the inside edge comes to about ¼ in. outside of the opening through which the clutch extends. This ¼ in. of the chain guard is then hammered back against the stop iron. The hole is thus made larger to provide space for the added circumference to the clutch when the toothed band is put on its outer surface.

The lower stop, Fig. 6, is made of metal ¾ in. wide and ⅛ in. thick. This is riveted to the piece at *I*, Fig. 5. A stop bolt *J*, Fig. 6, is put on as shown to keep the starter-arm from turning past its throwing position. The band *I* and the guard are held firm at the lower part with a U-shaped piece of iron *K*, Fig. 2. This piece is bolted to the engine bracket. A spring Fig. 7 is made of No. 8-gage brass wire and is fastened on with the stop, as shown at *L*, Fig. 5. Its purpose is to hold the starter-arm in position when not in use. The foot pedal *M* of the starter is shown in Fig. 2 and 4. It is made by putting a sleeve over a bolt that has been threaded to fit in the end of the arm. An ordinary bicycle pedal may be used instead, which will give a better appearance.



Side views of the engine crankcase showing the location of the kick pedal and the pedal lever for the brake and clutch with connecting rods and details of the footboards

Operation of the Starter

When the pedal *M* is pushed forward, the left arm with the catch *F* slides down the incline of *N*, Fig. 5, and is pulled toward the toothed band by the spring *E*, Fig. 2. The catch engages in the toothed band and the pedal *M* is given a quick downward push which starts the engine. When the foot is taken off the pedal it is pulled back by the spring *C*, Fig. 4, and as soon as it starts back the left arm slides up the incline *O* which keeps the catch *F* away from the toothed band. The arm in this position is shown at *P*, Fig. 5. This makes it possible to start the engine with the rear wheel on the ground, when the clutch is thrown out of action.

The Footboards

The pedals being removed, it is necessary to provide some support for the feet. To do this, footboards are supplied as follows: A bent bracket is made as shown in Fig. 8. The pieces *Q* are made of ½-in. square iron, 7½ in. long, flattened at the upper ends for holes. The piece *R* is made of iron 11¼ in. long, 1 in. wide and ¼ in. thick, and is riveted to the pieces *Q* as shown in the illustration.

The piece *R* should extend about ¼ in. at both ends over the pieces *Q* so as to prevent the hinge of the footboard from turning down. The hinge is shown in detail at *S*. The rear bracket is made of the same material as the front. The pieces *T* and *U* are fastened together with small bolts at the ends and stove bolts are used on each side of the frame at *V*. A split wood block *W* is made to fit in the frame as shown. The front of the bracket on each end will need to be twisted so that its surface will be in the same angle as the footboards.

The general dimensions and shape of the footboards are given in Fig. 9. They are made of hard wood and a rubber cut to the same size and glued to their surfaces. To make a neat finish thin strips of metal are cut about 3/16 in. wider than the thickness of the board and the rubber, and then tacked around the edges. The projecting edge of the metal strip above the board's surface is turned over and on to the rubber top. The front boards are then fastened to the hinge wing with small bolts. The rubber is put on after the boards are bolted to the hinge wings. The front bracket is fastened to the frame with the same bolt that holds the engine, as shown in Fig. 10 and 11.

The Foot Brake

The reconstruction of the crank-shaft and clutch leaves the machine without a brake. The brake, which is operated with one foot, is made as follows: The rear sprocket on the right side is removed. A lever is then attached in place of the sprocket to take the end of the brake-rod. The brake-pedal is shown in Fig. 12. The sleeve *X* is fastened under the engine in front of the square bottom, as shown in Fig. 11. The rod is made of machine steel. The brake-rod should be about 25¾ in. long. A small hole is cut in the front end of the chain guard for the brake-rod to pass through. The illustration clearly shows the construction of the brake parts. The lever *Y* may appear to be small, but if the brakes work right it requires very little pressure to slide the wheel.

The Foot-Clutch

Another improvement, which is not indispensable but is very desirable, is a foot-clutch control. The foot-lever for this is shown in Fig. 13, and is applied as shown in Fig. 10. As can be seen, it is attached by the same bolt as the regular clutch-lever. The corners on the outer end of the bolt are ground off and the sleeve of the foot-lever is put on over this. The rod from the clutch runs directly to the control-lever and another rod runs to the regular band lever. A collar *Z* is put on the foot-lever control rod.

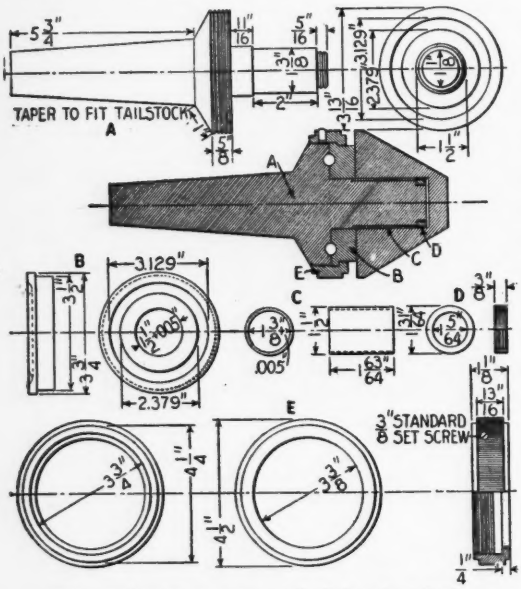
By using the foot-lever the clutch can be thrown either in or out; but with the hand-lever it can only be thrown out, as can be seen by referring to the illustration. These added features to an old style motorcycle have been in use for two years and have given entire satisfaction.

Iron and Steel Made Rust-Proof with Chemicals

IF iron is placed in a weak solution of phosphoric acid, a coat of insoluble ferrous phosphate is formed on it, which an oxidizing agent makes black and basic. If there is more acid phosphate, salts of calcium, magnesium, barium, or other alkali earth metal in solution, it will react much less violently than when free phosphoric acid is present. By using hydrated manganic oxide and air as oxidizing agents in the presence of this acid phosphate, a layer of black ferroso-ferric phosphate is formed of suitable thickness, rendering the metal rust-proof.

A Ball-Bearing Lathe Center for Large Holes

WHILE working with a lathe it is often necessary to turn objects in which the hole is larger than a solid lathe center,



Dimensioned parts for a ball-bearing lathe center of larger than usual proportions

such as pulleys, bushings and pipes. Referring to the drawing, *A* consists of one solid piece, being provided with a ball-bearing channel or race; *B* indicates the revolving swivel which bears the other half of the bearing channel. To fill the race there will be required twenty-three ⅜-in. steel balls. The extension is fitted with a bronze bushing *C*, and *D* is a knurled nut for holding the bushing *C* in place. The adjusting nut *E* holds the swivel *B* against the balls, thereby providing an extremely close running fit. In operation, heavy grease should be packed between the parts *A* and *B* for lubrication.—LEE S. FLETCHER.

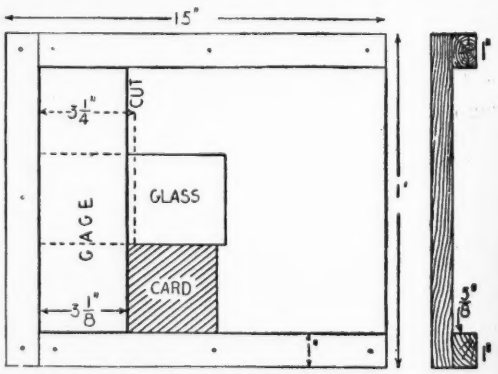
An Easy Method of Making Banana Liquid

TO make the so-called banana liquid, put 1 lb. of gun cotton into 1 gal. of acetone, and to the solution add 2 gal. each of amyl acetate and petroleum benzine. Add the amyl acetate first, then dissolve 20 oz. of gun cotton in 2 gal. of amyl acetate, and add 2 gal. of 90 per cent coal tar benzole or solvent naphtha. As these liquids are very inflammable, care must be exercised to keep the solution away from fire.

Holder for Cutting Glass and Photographic Plates

THE increased use of lantern slides as well as of plates for the vest pocket cameras calls for a size not easily obtainable in the various kinds. Where a particular make of plate is desired and cannot be had in the proper size, the convenient method of cutting glass for lantern slides and plates for vest pocket cameras, from the more common size plates as illustrated, may be appreciated. This arrangement may be used in the dark-room for cutting unexposed plates. It consists of a board 15 in. long by 12 in. wide for the base and a built-up edge on three sides with 1-in. strips ⅝ in. thick. A gage is made of a piece of wood 10 in. long, 3⅛ in. wide and ¾ in. thick to fit snugly between the raised pieces on the sides. It is necessary to have the gage adjust itself automatically, and for this reason its width must be the same as the required plates, allowance being made for the width of the axle support on the glass-cutter. This measurement is usually about ⅛ in., but will vary somewhat on different makes of cutters.

The best method is to measure the cutter accurately by placing the gage along a fine line drawn with a pencil on a white card and making a line parallel to this with the wheel of the cutter. The distance between these lines is allowed on the gage. The upper surface of the base is covered with a piece of baize to prevent slipping. In use place the plate gelatin-side down, with its end against the raised end and the gage in position over it. As the gage or glass cannot slip, an accurate cut is the



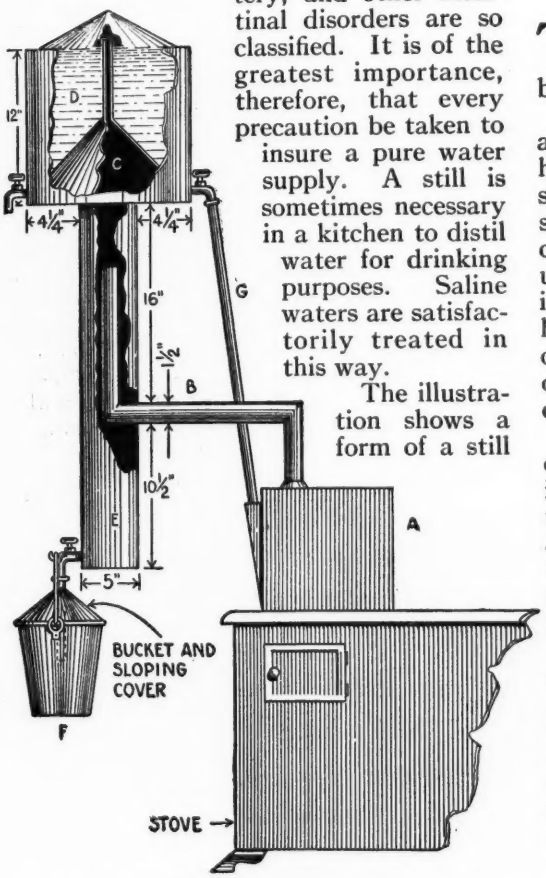
A gage-board for cutting unexposed photographic plates accurately in a dark-room

result. If the plate required is rectangular, then it is necessary to have a gage for the length as well as for the width.

A Household Water-Still to Purify Drinking Water

SOME diseases are so uniformly transmitted by water that they are known as "water-borne" diseases. Typhoid, dysentery, and other intestinal disorders are so classified. It is of the greatest importance, therefore, that every precaution be taken to insure a pure water supply. A still is sometimes necessary in a kitchen to distil water for drinking purposes. Saline waters are satisfactorily treated in this way.

The illustration shows a form of a still



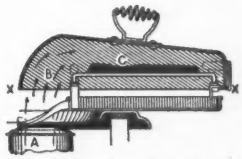
A still made of sheet copper for use on the kitchen range to purify the drinking water

which has been found effective and convenient for household use. It has the advantage of being inexpensive and can be constructed by any tinner. The still consists essentially of a water boiler *A* on the range, having a capacity of about 1½ to 2 gal., and a condenser suspended at the proper height from the ceiling. The pipe *B* conveys steam to the condensing chamber *C* and is kept cool by water in the compartment *D*. The distilled water collects in *E* and can be drawn off from time to time or allowed to run continuously into the bucket *F*. The metal used in the construction of the still should be well tinned copper and no solder should be exposed to the action of either the steam or distilled water. The pipe *G* is for carrying water to the boiler *A*, as the system is filled from the top of compartment *D*.

A Broiler for Use on Stoves Using Liquid Fuel

THE difficulty of broiling meats over a liquid fuel heater has been overcome by the invention of this broiling hood.

In oil fuel heaters a chimney is usually attached and the heat ascends in a sharply defined and swiftly mounting column. This column of heat pours into the overhanging hood and is forced downward and flows out, so that there is a continual movement or underflow of super-heated air.



Broiler-hood to be used with oil stoves

Well above the underflow line of this current—right in the center of the flow—is a grid on which the meat is placed, the temperature being practically if not actually the same all around the meat. It is therefore cooked perfectly and uniformly, with but slight attention on the part of the chef.

Well under the heated area—in a spot comparatively cool—the drip pan is located. This disposes of the grease, prevents flaring, sputtering, scorching and unpleasant soot deposit. The temporary detention of the heated air also causes the meat to cook more quickly than when the usual open-broiler method is used.

In the illustration, *A* is the source of heat and *B* the hood, with the meat *C* on the grid. The overflow line is at *X*.

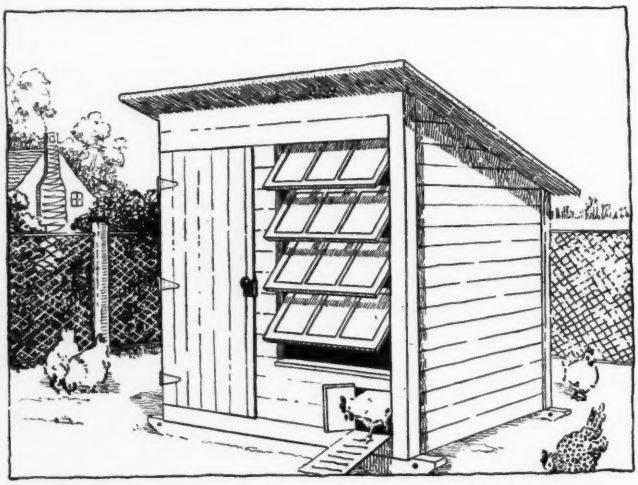
The handle of the grid is so formed that it will remain in either a horizontal or a vertical position. This is achieved by having notches in the wooden base—one on each side of each end and one at the crest of each end.

Wood That Is Most Suitable for Carving

OAK is the most suitable wood for carving, on account of its durability and toughness, while at the same time it is not too hard. Chestnut, American walnut, mahogany and teak are also desirable; while for fine work, Italian walnut, lime, sycamore, apple, pear or plum, are generally chosen in preference to all others.

Making a Small Colony Poultry House

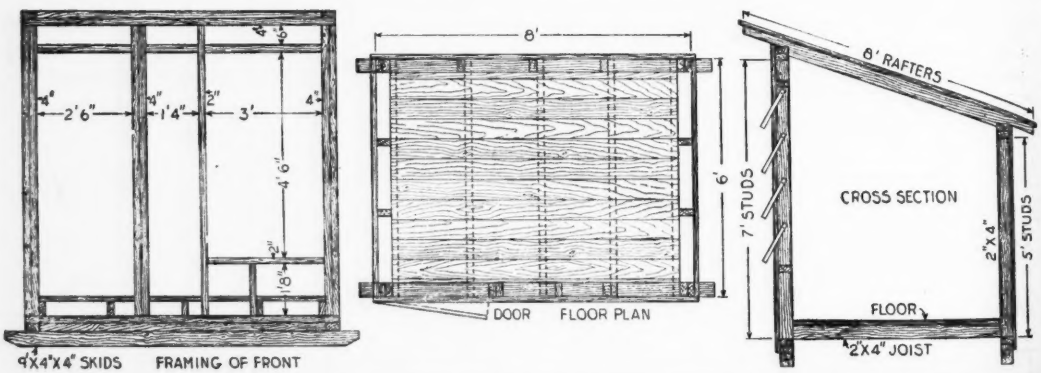
ANY American boy is carpenter enough to build this small colony coop, if these drawings and instructions are followed. It is a modern coop that will house from fifteen to twenty full-grown birds. It has been used with success at the Iowa Agricultural Experiment Station. It is built on skids or runners so that it can be hauled about to any desired place. The whole house is built on a frame made of 2 by 4-in. material well spiked together. This frame is covered with 6-in. flooring boards. The roof is covered with a prepared paper. The windows are the improved ventilating type as found in up-to-date coops, there being four small pivoted sashes. The poultry man can then open the windows part way or wide to suit the weather conditions. This way of ventilating the coop does away with the dangerous drafts that chill the fowls. The air here rises and mixes with the warmer air at the ceiling.



With this type of windows fresh air can be admitted to the house without causing dangerous drafts that chill the fowls

The lumber bill has been listed here and each item is marked so that the builder can tell just where each item is to be used. The list shows the sizes and the lengths of the lumber. Cut them all first and then spike the frame together. Cut all the framing lumber neatly and squarely, and to the exact lengths designated in the list. The first illustration clearly shows how the coop looks after it is all completed and ready for use.

First cut the skids or runners from timber 4 in. square, 9 ft. long. The ends should be rounded off a little, if the house is to be hauled about. Holes are bored in the ends of the skids so that a team can be hitched to it if wanted. Do the framing work on some level platform if possible. The skids are placed 6 ft. apart and then the sills are cut and set in place. Lap the corners and spike them well. The sills, you will note, are 2 by 4-in. pieces, but they are double thick. This is clearly shown. The outside of the sills are 6 by 8 ft.; that is to be the size of the house, outside measurement. Study the diagrams carefully and you will see just how all the 2 by 4-in. pieces fit together and where they belong in framing the front wall. The upright wall studdings are 7 ft. long and are capped off at the top with two 2 by 4-in. pieces spiked to the studding.



The studs for the framework are fastened on the upper surface of two sills shaped like the runners of a sled so that the entire house can be moved if desired with a team of horses

The floor plan drawing shows where each stud is to be placed.

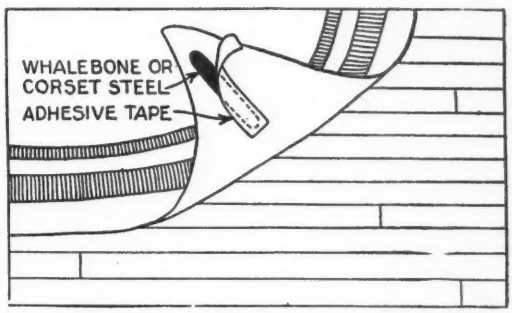
Frame the rear wall and set it up in place and then place the side wall studdings. Be sure that the walls are square, plumb and well-braced. Next set the roof rafters. They are 8 ft. long and are of the same kind of material as that used for the wall framing. The rafters are 2 ft. apart and the floor joists are of the same material.

When the frame is all up and solidly put together so that it will not rack out of shape, the siding can be nailed on to the framework. For siding, use just the ordinary 6-in. flooring lumber obtainable from any lumber dealer in your town. Nail the boards on closely and be sure not to leave any cracks. A draft is a dangerous thing in a chicken coop. The bird that catches cold soon passes out of the profit-making class. The walls of the house, the roof and the floor are all to be covered with this same kind of lumber. For the coop 300 ft. of flooring boards will be required. Make the door out of the same kind of stuff and use 6-in. boards for cleats and braces. The door will hang on 6-in. strap hinges. Leave the proper opening for the window sash which is 3 ft. by 4½ ft., as is shown in the framing diagram of the front. The opening for the door is 2½ ft. by 6 ft. in height. The illustration of the completed colony poultry house shows how the sashes are hung for ventilation. They are pivoted at the top and all are fastened to a rod so that the opening can be regulated to any desired degree. These are just the ordinary cellar sashes that are carried in stock by lumber dealers. There are three lights in each sash; the glass measures 10 by 12 in. for each one of the panes. The following is a list of materials for the poultry house:

2 pcs. 4 in. by 4 in. 9 ft. long for skids or runners
4 pcs. 2 in. by 4 in. 8 ft. long for sills (front and rear)
4 pcs. 2 in. by 4 in. 6 ft. long for sills (sides)
8 pcs. 2 in. by 4 in. 7 ft. long for front wall studding
8 pcs. 2 in. by 4 in. 5 ft. long for rear wall studs
4 pcs. 2 in. by 4 in. 6 ft. long for side wall or end studs
4 pcs. 2 in. by 4 in. 8 ft. long for top plates (front and rear)
5 pcs. 2 in. by 4 in. 6 ft. long for floor joists
5 pcs. 2 in. by 4 in. 8 ft. long for roof rafters
4 pcs. 1 in. by 4 in. 8 ft. long for corner finish boards
4 pcs. 1 in. by 4 in. 6 ft. long for corner boards (rear)
300 sq. ft. 6-in. flooring lumber for walls, roof, and for floor
70 sq. ft. 3 ply roofing material for roof
4 cellar sash 3 lts. 10 in. by 12 in. glazed ss.
3 6-in. strap hinges
1 door-lock complete for door

To Prevent the Corners of a Rug From Curling

HERE is a simple plan for preventing the corners of rugs from curling up. Cut four pieces of whalebone or corset steel,

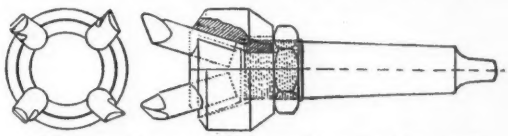


Simply made stiffener to hold rug corners down flat on the floor and prevent curling

each about 4 in. or 5 in. long, also four strips of adhesive tape a little longer. Turn the rug over and lay the whalebone in place as shown and fasten it down with the tape, pressing hard so that the edges will adhere firmly to the rug to keep the stiffening material in place.—J. E. McCoy.

A Multiple Tool Boring-Bar for Machinists' Use

OF unusual strength, compactness and perfect self-centering ability is the new milling and boring tool shown here, which is commanding considerable attention from machine-shop men. Rapid and clean boring work in a small shop or garage formerly had to be done by a single point tool or cutter—multiple point tools being either too large or too expensive for a small shop. When a single point tool is used, it is necessary to correct the chatter, the irregularities due to eccentricity, especially when

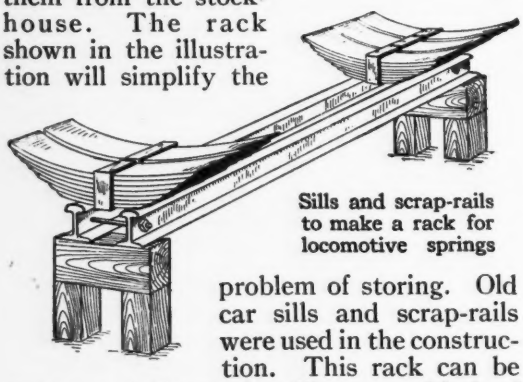


Self-centering multiple cutter boring tool which can be inserted in ordinary drill-chuck

operated at a fairly high speed. The simple arrangement shown in the accompanying illustration obviates all difficulties. The illustration is practically self-explanatory. Given such a cluster of tool bits, set in a conical socket adjustable by a single central thread, the result is a self-centering tool of variable diameter.

A Locomotive Spring Rack Made of Ties and Rails

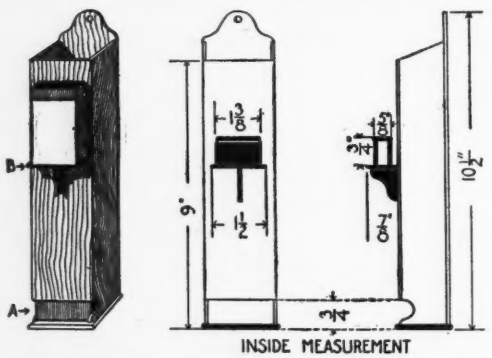
ON account of the weight and shape of locomotive driving springs it is difficult to handle them, especially in removing them from the stock-house. The rack shown in the illustration will simplify the problem of storing. Old car sills and scrap-rails were used in the construction. This rack can be used to facilitate handling any kind of bulky or unwieldy material of a similar nature.—J. R. MINTER.



Sills and scrap-rails to make a rack for locomotive springs

A Container for Small Safety Match Boxes

THOSE who buy safety matches in packages of 1 doz. boxes will find the rack shown to be very convenient. When the matches are purchased, the packages are opened and the boxes put into the container through the opening at the top. They are removed as needed through the slot *A* at the bottom. On the front there is a holder *B* for the box in use. This device may be made of metal or thin packing box wood and painted or stained as desired. The one illustrated was made for a standard match box which measures 2¼ by 1½ by 11/16 in. Allowance must be made in the dimensions when making other sizes of boxes.—H. T. LINTHICUM.



The match boxes are kept where they are easily located without a light at night

A Good Marine Glue That Will Not Become Brittle

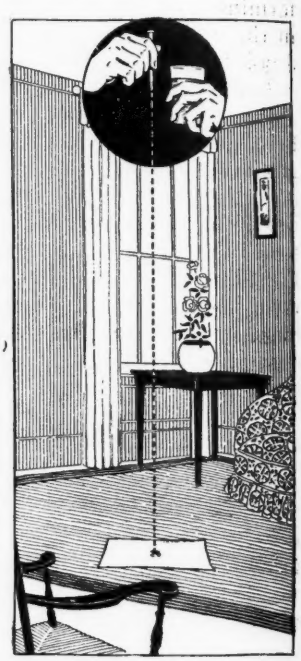
A GOOD marine glue, which should be applied hot to crevices, etc., and which becomes firm but not brittle when cold, is composed as follows:

Crude rubber	1 part by weight
Shellac	2 parts by weight
Pitch	3 parts by weight

The rubber is first dissolved in carbon disulphide or turpentine before mixing with the heated (not super-heated) mixture of the other two.

To Locate the Center of a Ceiling Readily

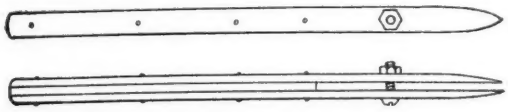
SOMETIMES when it is desired to hang a lamp or chandelier or do certain kinds of decorating, it is necessary to find the exact center of the ceiling, and when this is attempted unlooked-for difficulties arise. The best method to follow is to first measure the length and width of the floor of the room and mark a cross on a piece of paper so that its intersection will be the center. Without permitting the paper to be moved, hold a nail over the cross as accurately as you can and shove a glass of water up around it so that the nail is wet. When the glass is withdrawn, a drop will fall and if it falls directly on the junction point of the lines, you have the center. If it does not, you can shift the nail about and keep on trying until you make the drop fall true. This rule is useful for finding a spot directly overhead of any given point. It is always comparatively easy to get the location on the floor; then find the spot directly above.—H. ADLON.



The drop of water will fall vertically if there are no air currents

A Substitute for a Painter's Striping Brush

THE amateur who wishes to do a little striping but does not possess the requisite skill in using a striping-brush, can



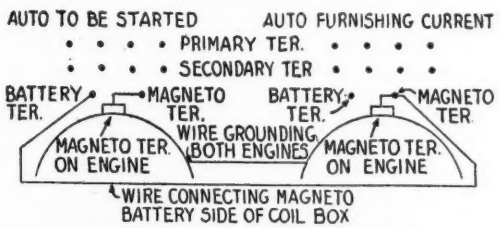
A pen like the draftsman's ruling pen made from wood strips for striping with oil paint

provide himself with an efficient substitute which consists of three strips of hard, close-grained wood, about ⅛ in. thick and ⅜ in. wide. Two of these strips should be about 8 in. long, the other about 5 in. long. The short piece is nailed between the others in the manner shown in the illustration, forming practically one piece with a slot in the end. This end should be shaped to a point.

About 2 in. from the end of the slot, drill a ⅜-in. hole and insert a stove-bolt. This bolt is used to adjust the space between the points or nibs. To any one familiar with an ordinary ruling pen it is obvious that this is simply the same thing on a larger scale and is operated in the same way. Care should be taken that the paint used is not too thin, as it is liable to spread. A little practice is advisable before making a stripe which is to remain on the piece to be finished.—FRANK L. MATTER.

Starting Automobile with Current Taken from Another Car

AFTER the engine on a Ford car has been overhauled it is usually pretty stiff and hard to crank fast enough to start on the magneto. The engine may be started by the current from another similar



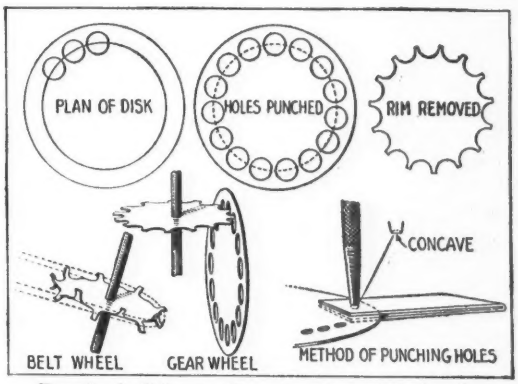
Wiring diagram to connect magneto of one car with another for starting engine

car, as shown in the illustration, by the use of two small wires and by turning the switch key of the overhauled engine to the battery side. Of course, after the engine starts the key is turned to the magneto side and it furnishes its own current.

This method can be used to locate trouble in the magneto also; for, if the engine runs all right when connected with the current from the other magneto, its own magneto must be faulty.—L. E. NOFSINGER.

Making Small Gears for Emergency Use

IN the making of models it is sometimes necessary to use a drive for speed that cannot be obtained with stock gears. Where there is no gear cutter at hand, or the cost for making them is too much, the simple makeshift illustrated will easily supply the experimenter's wants, and the cost is practically nothing. They are made from sheet metal, the teeth being formed by punching or drilling holes in a circle drawn on the surface. These holes should be evenly



Punched disks to form teeth and holes for making gears to run models or a cord drive

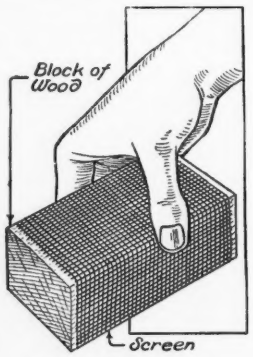
spaced, then after punching or drilling, the outside should be cut away on the circle drawn. This leaves half of the portion of the metal between the holes extending like teeth. The wheel into which these teeth mesh is made in the same manner, but instead of cutting away the outside it is left intact, as the teeth of the other wheel will enter the holes and drive it.

The device used for making the holes by punching is shown in the illustration. It is made of heavy sheet metal bent in a closed U-shape, the ends being drilled to make holes for admitting a punch. These holes will guide the punch when making the holes in the disk. The disk is placed between the ends of the metal.

An excellent drive for a cord may be made in this way.—ROBERT C. KNOX.

A Wire Scraper for Cleaning Stone Surfaces

WHEN the stone window sills of a house need cleaning, to get into the surface deeper than a brush would do, this device may be used. A block of wood 4 in. long, 2 in. wide and 1 in. thick, should be cut from a piece of timber and covered with screen wire. The block should be given the shape of a chisel edge so that corners may be reached easily. The screen wire is drawn over the scrubbing block tightly and fastened securely with tacks along the center.—GEORGE BUSH.



Screen on block to clean stone surfaces

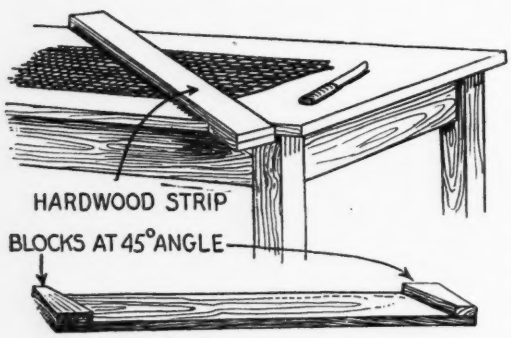
Making a Substitute Wood Handle for the Dustpan

THE most frequent cause for buying a new dustpan is the breaking of the handle. When this happens do not throw the pan away, but procure a piece of pine and whittle out a handle to fit the inside of the broken one. Then saw the end on a bevel to fit the pan. When driven into the handle and held with screws this makes a better and stiffer handle than the original.

To Cut Automobile Tire Fabric on an Angle

A WET knife drawn quickly across the fabric is a better method of cutting than with shears. A straight-edge with blocks that have 45 deg. edges nailed to either end is necessary for cutting the angle. In cutting, one end is evened up against the edge of the table and a perfect 45 deg. cutting angle secured.

After the gum or fabric is peeled off, the holland strips are soaked until they are soft. They make excellent gasoline rags.

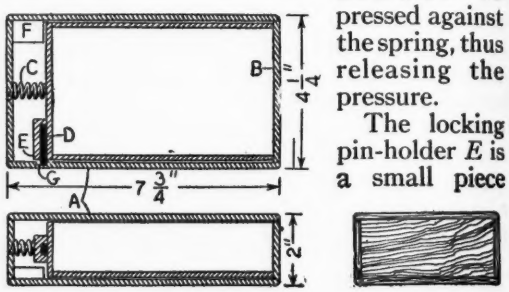


A heavy straight-edge for placing on a table to guide the knife in cutting the fabric

A Puzzle Box with a Concealed Latch Pin

THE original of this box was made in China, but a duplicate can be easily made as it is only a plain box into which a drawer slides. By holding the box in the correct position and pressing the drawer in, it can be opened repeatedly in the presence of guests without giving the secret away. The illustration shows the box in detail. The box *A* has one end open for the drawer *B* to enter. This should be an easy sliding fit. The front should fit snugly into the box end. The spring *C* holds the locking pin *D* in position. This pin is of iron or steel so that its weight will cause it to drop into or out of position when the drawer is pressed against the spring, thus releasing the pressure.

The locking pin-holder *E* is a small piece of wood with a groove cut in it. This holder is closed on one end to prevent the pin from dropping out, and is glued to the back of the drawer. The drawer stop *F* is glued to the bottom of the box and is just long enough to allow some play for releasing the locking pin. Before putting the box together the groove *G* is cut in its side to take the end of the locking pin. If made to the dimensions given, wood ¼ in. thick is suitable and 3/16-in. stuff for the drawer. To open the box, press the drawer in and turn the box on its side so that the locking pin will drop out of the groove *G*. The drawer will then spring out from the pressure of the coil spring. The movements by which the box is opened can be made very quickly and without attracting attention.—JOHN TANNAHILL.



The latch is worked by gravity when it is released by a slight pressure on the drawer

Winning an Athlete's Laurels

II—JUMPING EVENTS

By Albert B. Wegener

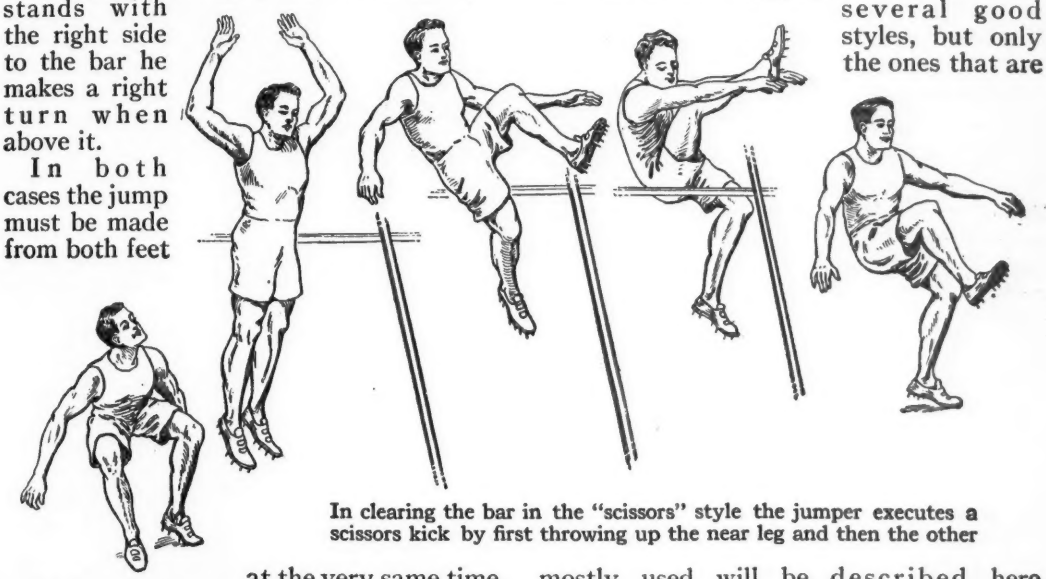
A technical instructor and director of athletics of twenty-seven years' experience

THERE are two good styles for making the standing high jump—the "scissors" and the "roll over," in both of which the jumper stands with side to the bar and about 18 in. from it, and jumps sideways over the bar.

In clearing the bar in "scissors" style the jumper executes a scissors kick by first throwing up the near leg and then the other, just as in the high kick.

In clearing the bar in "roll over" style the jumper extends his body lengthwise of the bar and rolls sideward over it, as in the hopping style high jump. If the jumper stands with the right side to the bar he makes a right turn when above it.

In both cases the jump must be made from both feet at the very same time.



In clearing the bar in the "scissors" style the jumper executes a scissors kick by first throwing up the near leg and then the other

The feet of the competitor may be placed in any position, but they must leave the ground only once in making an attempt to jump. When the feet are lifted from the ground twice, or when two springs are made in making the attempt, it counts as one trial jump without result. A competitor may rock forward and backward, lifting the heels and toes alternately from the ground, but must not lift either foot clear from the ground or slide it along in any direction on the ground.

With these exceptions, the rules are the same as those for the running high jump.

When training, do not take more than ten or twelve jumps a day, and even then allow plenty of time to intervene between jumps. This time should be used in massage and stretching the legs and in breathing deeply. If the muscles are sore take a rest until the soreness is gone, meanwhile applying massage and hot baths to them.

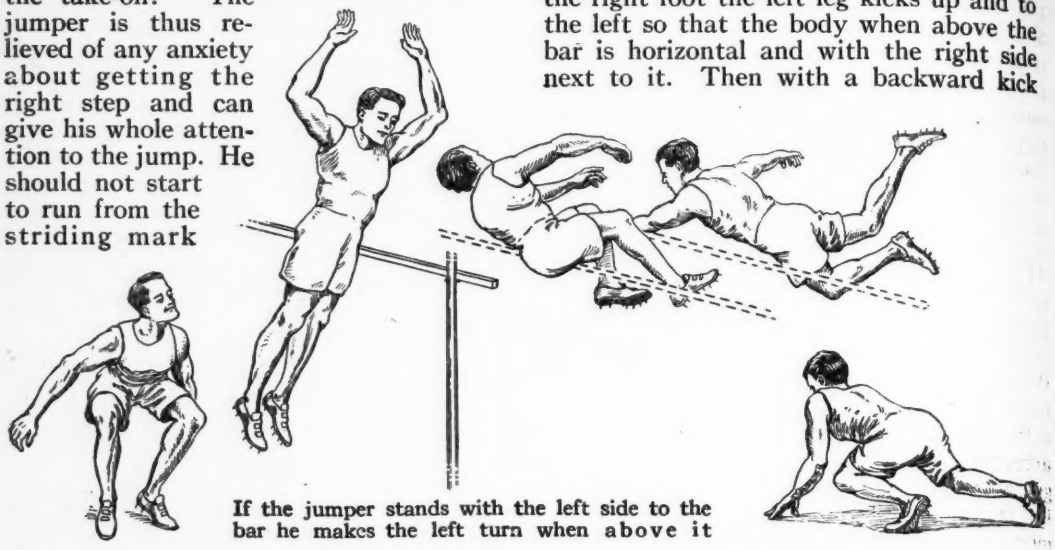
The Running High Jump

This event is always put on an athletic program and is one of the most popular of field events. The best jumpers are tall and slender, but some short men have done remarkably well by persistence. There are several good styles, but only the ones that are mostly used will be described here.

The approaching run should be carefully planned. Make a mark on the ground three-quarters of the distance of the height of the bar from a spot just beneath it. This is the "take-off," or jumping spot which the jumper must be sure to meet with his jumping foot every time. Some jumpers prefer a distance the height of the bar, while others always jump from a 6-ft. mark. Each jumper must select his own best distance.

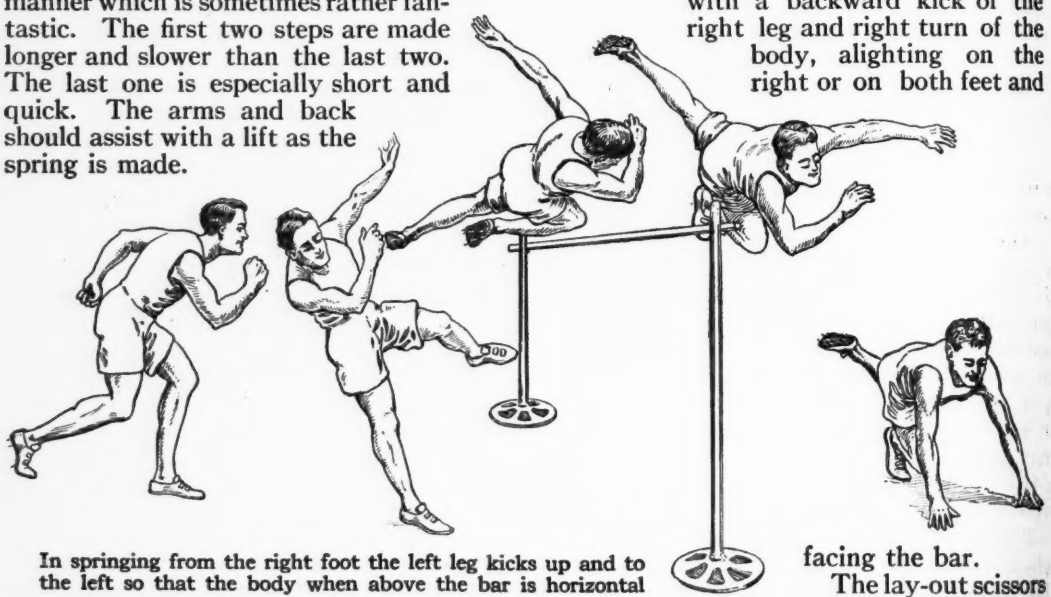
Four strides from the take-off make another mark, the "striding mark." These four strides should be the same as you use in jumping and not mere "stepping off,"

since it is from this mark that the real run is made. If the jumping foot steps on the striding mark it will be sure to do so on the take-off. The jumper is thus relieved of any anxiety about getting the right step and can give his whole attention to the jump. He should not start to run from the striding mark



If the jumper stands with the left side to the bar he makes the left turn when above it

but from several steps back of it, and he must be sure to meet it with his jumping foot as he approaches. The run must be at right angles to the bar or nearly so. Some jumpers prefer to run at about 45 deg., but one should never run any closer. The four steps between the striding and take-off marks are the most important. They are made in a crouching and irregular manner which is sometimes rather fantastic. The first two steps are made longer and slower than the last two. The last one is especially short and quick. The arms and back should assist with a lift as the spring is made.



In springing from the right foot the left leg kicks up and to the left so that the body when above the bar is horizontal

Clearing the Bar

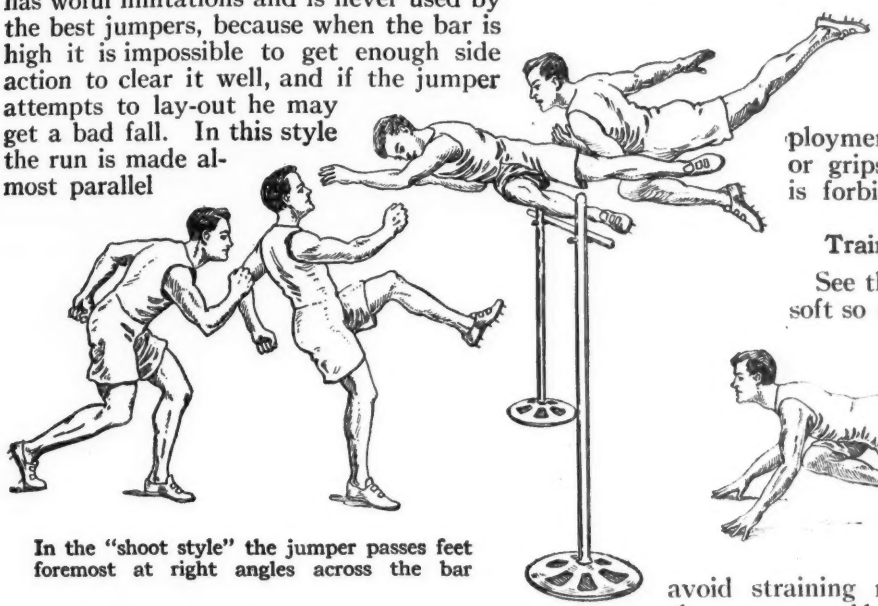
The following three styles are considered the best:

The hopping (roll over) style is perhaps the simplest. The athlete jumps and alights on the same foot. In springing from the right foot the left leg kicks up and to the left so that the body when above the bar is horizontal and with the right side next to it. Then with a backward kick of the left leg and a right twist of trunk, he faces down and alights on hands and right foot.

In the "shoot style" the jumper does not lay out lengthwise of the bar, as in the hopping style, but directly across it at right angles, feet foremost, with right leg bent, left straight, right side next to the bar. The jump is completed in this manner with a backward kick of the right leg and right turn of the body, alighting on the right or on both feet and facing the bar.

The lay-out scissors style is more difficult than the other two on account of the reverse twist. In jumping from the right foot, plant it on the take-off mark almost

parallel with the cross-bar, then kick the left leg upward to the right. Follow with a kick from the right leg in the same direction. This brings the jumper horizontal and almost parallel with the bar and above it and with the right side next to it. This is followed with a backward and downward swing of the right leg and an additional right turn so as to alight facing the bar on the right or both feet. The run should be at right angles to the bar or nearly so, so that it is not confused with the novice scissors style, which is sometimes called "The novices' delight," because it is easy to do and the beginner can make a higher jump with it than with the others. But it has woful limitations and is never used by the best jumpers, because when the bar is high it is impossible to get enough side action to clear it well, and if the jumper attempts to lay-out he may get a bad fall. In this style the run is made almost parallel with the bar and the jump is like the scissors high kick.



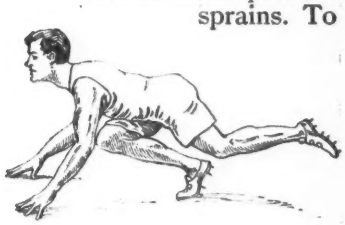
In the "shoot style" the jumper passes feet foremost at right angles across the bar

The uprights for a high jump must be at least 12 ft. apart and must not be moved during the competition. The take-off ground about the jump must be level. As soon as a jumper makes a spring in order to jump, it counts as a trial. A line drawn 3 ft. in front of the bar and parallel with it, is known as the balk line, and stepping over such line in an attempt, is counted as a balk. Two successive balks count as a trial jump.

The field judges decide the height at which the jump commences and regulate the succeeding elevations. Three jumps are allowed at each height, and a failure at the third attempt disqualifies the contestant. A competitor may commence at any height above the minimum height. At each successive height each competitor takes one trial in his proper turn; then those failing, if any, take their second trial jump in like order, after which those having failed twice make their third trial jump. A competitor may decline to jump at any height in his turn, but by so doing he forfeits his right to jump again at the height declined. The jump is made over a bar resting on pegs projecting from the uprights, and when this bar is removed from its place it is counted as a trial jump. Neither diving nor somersaulting over the bar is permitted. All measurements are made perpendicularly from the ground to the upper side of the bar, where it is lowest. The employment of weights or grips of any kind is forbidden.

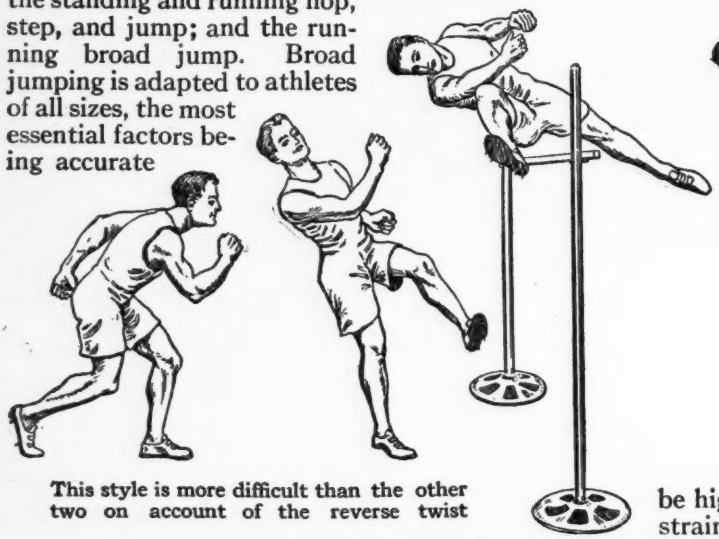
Training Hints

See that the pit is soft so as to prevent sprains. To avoid straining muscles, keep them warm. Always do some preliminary jogging, stretching and massage of the muscles before jumping. Take only ten or twelve jumps a day, three days a week. If a stiffness comes on, rest and apply massage for several days. The best jumpers wear special jumping shoes with six spikes in front and two at the heel, and a piece of rubber sponge in the shoes to prevent bruising the heels. Learn to alight on both feet, or better still on all fours, to avoid excessive work for the jumping leg. Practice at several inches below your contest mark and do your best only once a week. On alternate days practice sprinting and jogging. Preliminary training should be largely sprinting, high jumping, and accurate striding between marks. If the feet or ankles are even a little lame or strained, rest and apply massage until better.



Broad Jumps

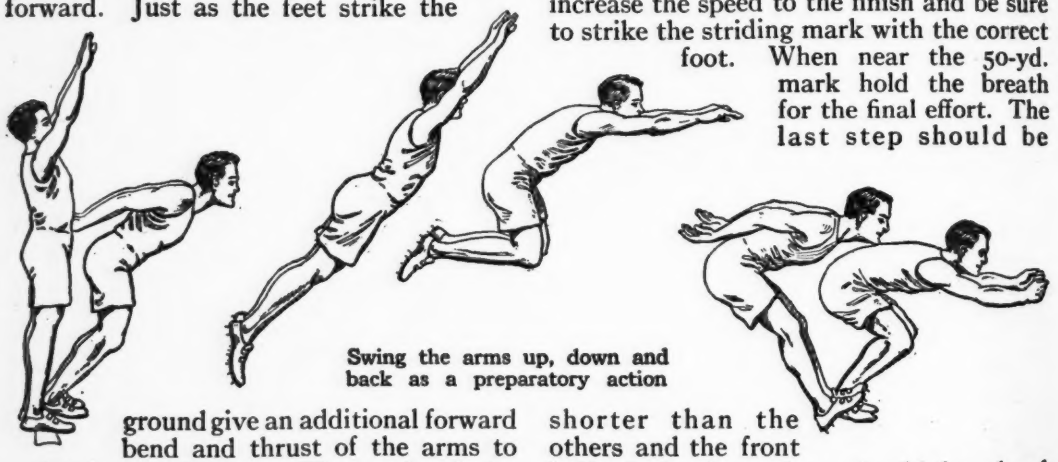
Under the head of broad jumps are included the standing one, two and three; the standing and running hop, step, and jump; and the running broad jump. Broad jumping is adapted to athletes of all sizes, the most essential factors being accurate



This style is more difficult than the other two on account of the reverse twist

stepping and a very powerful spring.

To make the standing broad jump, stand with the feet together, the large joints (ball of the feet) just above the edge of the block. Swing the arms forward up, then downward and back as a preparatory action. Then incline the body forward, flex the thighs and legs at about right angles. In the act of jumping, use all the force possible in the forward arm swing and back lift as well as the leg spring. In sailing through the air raise legs and bend well forward. Just as the feet strike the ground give an additional forward bend and thrust of the arms to maintain the balance. The angle of the jumper's body as he leaves the block will determine whether he will jump high or low. The proper angle is not easy to get from the sharp edge of the block.



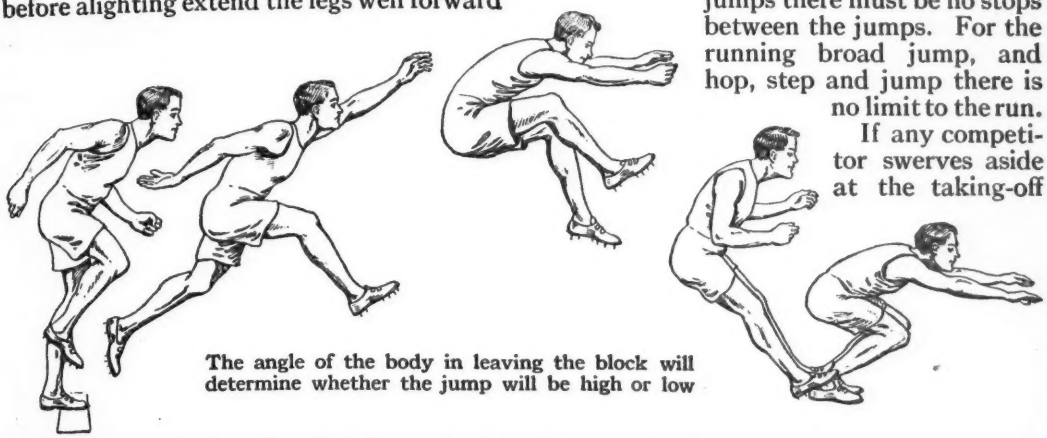
Swing the arms up, down and back as a preparatory action

In the standing hop, step and jump, the start is made from one foot; the other foot and the arms swing forward and backward in order to get an impetus.

In the running hop, step, and jump, there should be a fast run of about 80 ft. The hop should not be high or there will be too much strain on alighting and the step and jump will be weak. Make the hop low, and the step moderate, and put tremendous effort in the high and broad jump. The running broad jump rules govern this event.

In the running broad jump the greatest factors are speed, a good take-off, and a vigorous rising spring. Striding is important and should be practiced much. To help the stride place a mark about 20 ft. from the block, another about 50 ft., and the start at about 100 ft. Take a few long breaths before starting the run, gradually increase the speed to the finish and be sure to strike the striding mark with the correct foot. When near the 50-yd. mark hold the breath for the final effort. The last step should be shorter than the others and the front half of the foot alone should be placed upon the block. The run should not be made too fast else it will be impossible to jump high enough. The position of the striding marks vary if there is a strong wind either ahead or behind. If you overstep the block

do not finish the jump, since it will not count anyhow. In soaring through the air bend forward and raise the knees. Just before alighting extend the legs well forward



The angle of the body in leaving the block will determine whether the jump will be high or low

to gain every inch. On alighting jab the feet downward to avoid sliding. It is not good form to alight sideways, because there is greater danger of falling back or of turning an ankle. In case you fall backward hop back a few inches rather than fall flat.

Rules That Govern All Broad and Standing Jumps

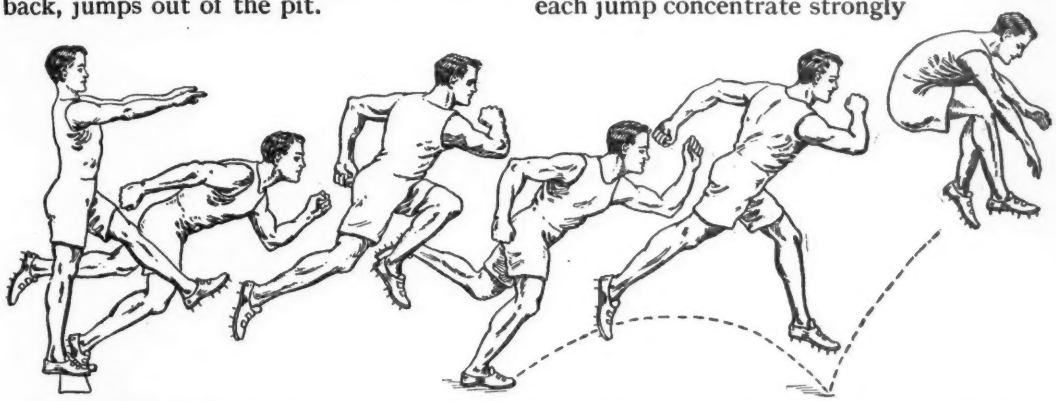
Each contestant has three jumps and the best five three more jumps. The best (not necessarily the last) jump is the contestant's record. The nearest mark made by any part of the jumper's anatomy on the ground is measured at right angles to the near edge of the jumping block. This applies even though the jumper, in falling back, jumps out of the pit.

When starting for a standing jump, if the foot of the jumper leaves the block more than once, or slides forward, it counts as a trial jump, but is not measured. The jumper may, however, raise and lower his heels as often as he likes preparatory to jumping. In the two and three broad jumps there must be no stops between the jumps. For the running broad jump, and hop, step and jump there is no limit to the run.

If any competitor swerves aside at the taking-off line, or the line extended, or touches the ground in front of the take-off joist with any part of his foot, such a jump is not measured; but it is counted against the competitor as one jump. A line is drawn 6 ft. in front of the scratch line, to be known as the balk line, and stepping, or falling, over such line, or such line extended, in any attempt, is counted as a "balk," and two successive balks are counted as a trial jump. The rules for the running high jump shall govern.

Training Hints

Take only 8 or 10 jumps a day, three days a week, wearing sponge rubber in the heels. See that the pit is soft. Before each jump concentrate strongly upon it. To get height in jumping place an obstacle in the pit 3 ft. high, 8 ft. from the block. Train as for sprinting.

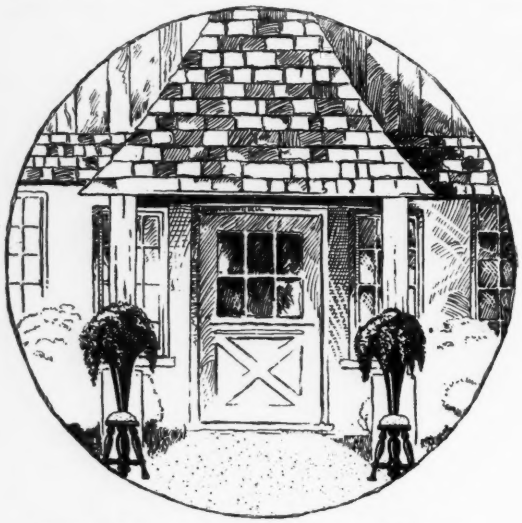


In the running hop, step, and jump, there should be a fast run of about eighty feet. The hop should not be high or there will be too much strain on alighting and the step and jump will be weak

(To be continued)

Using Old Phonograph Horns for Vases

WHILE in the musical instrument business I had left on my hands two old phonographs that were useless as musical instruments. In figuring out what

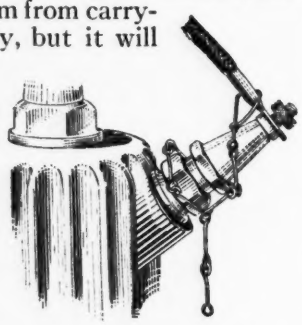


Decorative vases made from old phonograph horns cemented to piano-stool pedestals

to do with them I concluded to use the horns in the manner illustrated. I first bored holes in two old piano stools and, after inserting the small ends of the horns, I reinforced the joints with cement. The depth of the horns prevent the plants from drying out rapidly.—J. C. GRINDELL.

To Prevent a Motorcycle Theft by Short-Circuiting Spark-Plug

THIS device is to prevent a thief from getting away with your motorcycle. It will not keep him from carrying it away bodily, but it will prevent him from starting the motor. The lock consists of from 5 to 7 in. of dog-chain, brass or steel, attached to a wire or flat brass piece bent to a narrow V-shape to embrace the terminal. This V-shaped piece has a loop at the end to which the dog-chain is attached. The method of operating the safeguard is to put the bent wire over the terminal and to take a half-hitch of the chain around the hexagon section of the plug. In this position the current cannot pass to the plug.



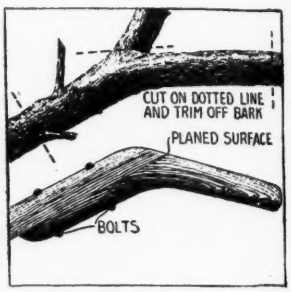
The chain attached to make a short circuit

The half-hitch around the plug will short-circuit the plug and further prevent the would-be thief from shaking it off in pedaling. The chain should be nickeled to correspond with the nickel of the spark-plug. The brass wire is practically the same color as the terminal, so as to escape the notice of the thief. If the half-hitch is well made, as shown, the device can be removed only by undoing the hitch.

For sidecar use it is a first class lock. When detached the wire and chain can easily be carried in the pocket. Cables can be tested with it by putting on the wire and watching the spark pass from the end of the chain to the cylinder. It is necessary that you wear gloves when making this test.—WILLIAM H. SMITH.

Repairing a Broken Curved Implement Handle

A BROKEN curved handle on a garden implement can be easily replaced with a piece of wood cut from the forked branch of a tree. The illustration clearly shows that part of the branch used in making the handle. It is cut out and carefully shaped, after which it is attached by means of rivets.—A. S. THOMAS.



Curve cut from branch for implement handle

The Necessity of a Thorough Buffing for Tire Repairs

CUSHION gum should always be used between the fabric and the tread stock of a tire, as it permits a much firmer union. If the surface of a casing is not first roughened sufficiently, outside patch repairs will usually loosen in use. An overflow of material beyond the place where it is needed will also cause it to peel off. Thorough buffing and cleaning off are the best preventatives.

The Amateur Electrician

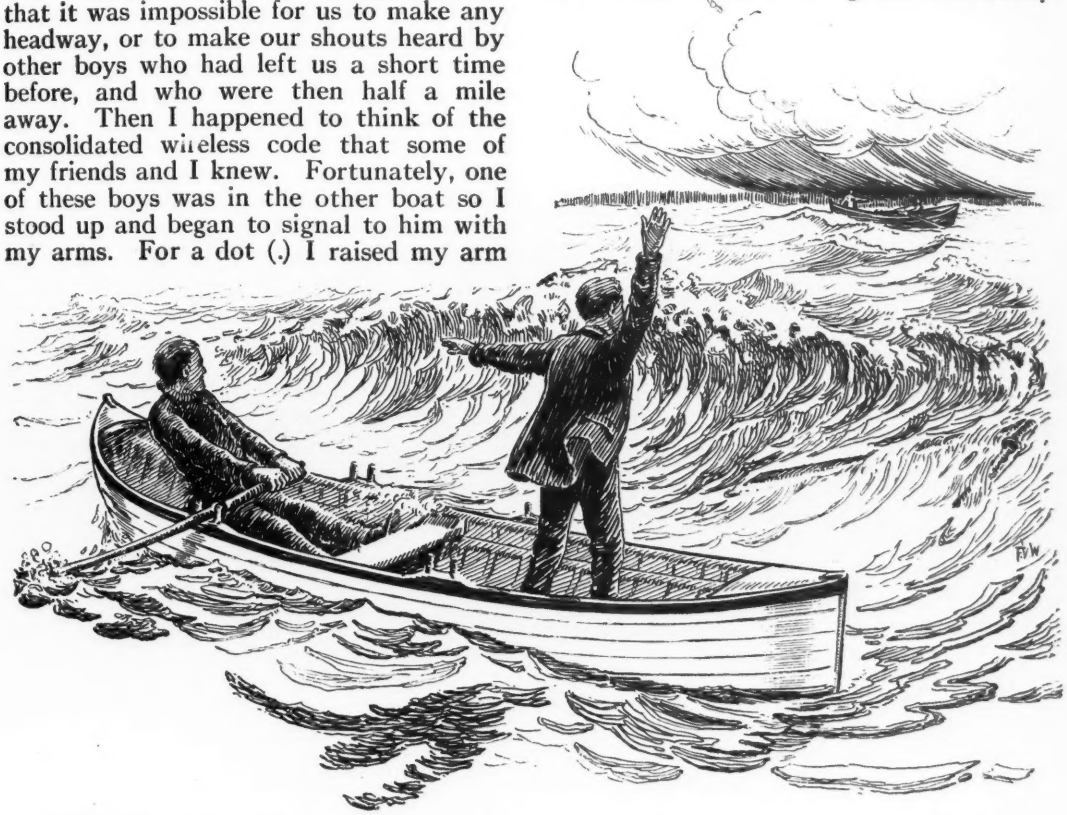
And Wireless Operator

Signaling "by Wireless" Without Instruments

WHILE some of my friends and I were out fishing, an accident happened to one of our oars, leaving us with only one. There was a very strong wind, so that it was impossible for us to make any headway, or to make our shouts heard by other boys who had left us a short time before, and who were then half a mile away. Then I happened to think of the consolidated wireless code that some of my friends and I knew. Fortunately, one of these boys was in the other boat so I stood up and began to signal to him with my arms. For a dot (.) I raised my arm up over my head and let it come back quickly, for a dash (—) I held my arm up a little longer. By sending S O S two or three times I managed to attract his attention and told him our trouble. They came to our rescue and helped us back to the shore.—R. H. M., Jr.

Experiments with Static Electricity from Belts

SOME interesting and very amusing experiments can be made with static obtained from overhead belts in a machine-shop, the phenomena being due to friction. Hold a metal rod to within a few inches of the belt with one hand, while with the other touch someone who is in contact with a machine forming a ground. A distinct shock will be felt by both parties. A finger held near the machine will cause a spark, its size depending on the strength of



Sending the signal of distress to friends in a distant boat with the use of dots and dashes of the consolidated wireless code spelled out by waving the arms in a manner to suggest the code

the static. Further experiments may be conducted by "bottling" this wonderful agency in a Leyden jar, which is nothing more than a wide-mouthed glass jar with a wood cover, through which a brass chain is depended, and whose outside surface is partly covered with tinfoil. To gather the static, place the transmitting rod against the ball that tops the chain. A powerful discharge is released when contact is formed between the ball and the tinfoil. A glass tumbler filled with water offers a substitute for the Leyden jar and is charged by immersing the rod. Offer the glass to a friend —and watch the fun.—JOSEPH J. STEEDLE.

Making a Hot Wire Ammeter for Electric Currents

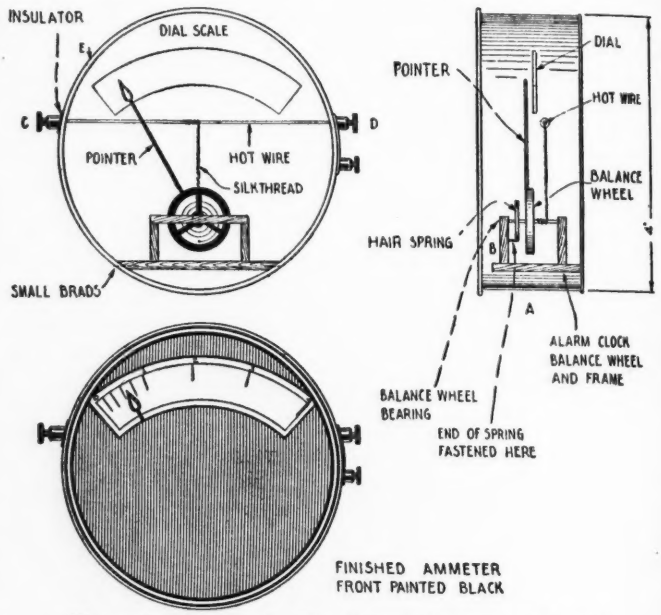
A HOT wire ammeter is nothing more than a piece of wire which expands when a current is sent through it. This expansion is taken up by a balance wheel which moves a pointer along a scale calibrated to read in amperes. The sensitive or movable parts of this hot wire ammeter are a balance wheel and hair-spring which are taken from the works of an old alarm clock. When taking out the balance wheel and hair-spring the framework with the bearings should also be taken out and the other part of the works cut away with a pair of tinner's snips.

The balance wheel and its bearings are mounted on a piece of wood or fiber, which is nailed to the alarm clock casing with small brads, as shown at *A*. The end of the spring is attached to the post *B*. After the balance wheel is put into tension by rotating the wheel a few times a piece of silk thread should be tied to the balance wheel spoke and wound five times around the axle of the wheel. The thread should be wound in the direction which will hold the tension of the wound-up spring.

The hot wire is a piece of No. 36-gage platinum or German silver wire. This is stretched between *C* and *D*, which should be well insulated from the casing *E*. The thumbscrew *D* is used to adjust the pointer by tightening the hot wire. The pointer should be made either from a piece of sheet aluminum or a piece of light, stiff wire. It is painted black and tied to one of the spokes of the balance wheel after the thread has been pulled so that the spring is under tension. Adding a drop of wax or glue will make a stronger joint.

The dial is made from a piece of cardboard and is glued to the sides of the alarm clock. It is placed in back of the pointer and in front of the hot wire, and may be divided off according to the range of the instrument. The hot wire ammeter is provided with a glass which is painted black. In putting the parts together the balance wheel and parts are put in the clock casing first; then the dial is glued in, the hot wire is placed in position and the thread from the balance wheel is tied to it.

When the antenna-current passes through *C* and *D* the hot wire expands, which tends to leave a slack in the silk thread. This is taken up by the tension of the spring, and causes the axle to wind up, making the pointer move along the scale. When the current stops flowing through *C* and *D* the hot wire shortens it up and the pointer returns to zero. The hot wire ammeter will make a useful addition to any wireless station, and is particularly handy for tuning. The success of the instrument depends largely on the care taken in its construction, for although simple it is delicate and requires more accuracy in

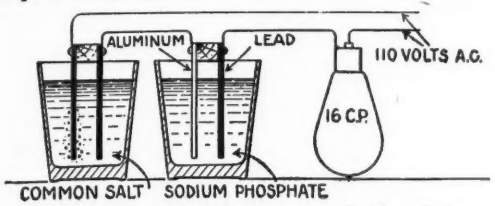


The casing and works of a discarded alarm clock used for making an especially delicate hot wire ammeter

making than the ordinary and cruder apparatus.—EDWIN JASPERS.

Interesting and Instructive Electrical Experiments

THE accompanying diagrams illustrate three interesting electrical experiments that may be made with the regular 110-volt lighting current at practically no expense whatever. The first demonstrates

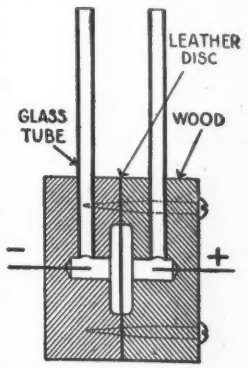


Experiment with salt water and phosphate solutions for a rectifier and polarity indicator

the electrolytic rectifier. Procure a strip of lead and one of aluminum about 1 in. wide and 3 or 4 in. long. Tack these to a piece of wood so that they can be suspended in an ordinary drinking glass as indicated. This is the rectifier. Fill the glass about three-fourths full of water and add about a spoonful of sodium phosphate.

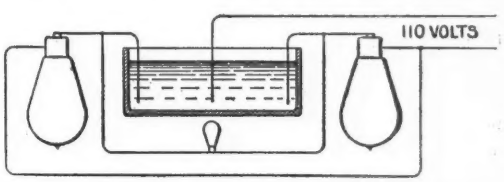
Another glass should be provided and filled with ordinary salt solution. Two metal strips should be arranged in this glass the same as in the other, except that both must be of the same metal—copper, tin or whatever is most convenient. Connect up as shown with a 110-volt alternating current, placing a 16-candlepower lamp in the circuit. Immediately bubbles will be seen rising from one of the strips in the salt solution, thus indicating the negative pole. Temporarily short-circuit the rectifier, and the difference between the two strips in the salt solution will immediately disappear as the current becomes alternating again. If a small galvanometer is at hand place it in circuit and it will be seen that when the rectifier is in circuit the needle is deflected, thus indicating a current in one direction only. Short-circuit the rectifier and no deflection occurs, although more current is flowing, as indicated by the increased brightness of the lamp. If no galvanometer is available, wrap some fine magnet wire around a pocket compass and the same result will be secured.

It is a property of the electric current to carry liquids along with it in its passage through membranes. This property is made use of in electrotherapeutics where certain medicaments are made to penetrate the tissues by placing them in contact with the skin and passing a current through the liquid into the body. This phenomenon may be readily displayed by the simple apparatus illustrated. Procure two blocks of wood about 1 in. thick and 2 in. square. Hollow out the centers as indicated and bore a hole at each corner so that they may be clamped together with screws. Get two lengths of 3/16-in. glass tubing 3 or 4 in. long, and tightly insert these in the blocks as shown. Also run in the tip of a wire at the center of each block, after which shellac the spaces hollowed out in order that they may withstand the liquid and avoid leaking. Place a sheet of thin leather between the blocks and clamp together. With an eye-dropper fill the interior through the tubes with a solution of common salt. Stop when the level rises in the tubes so that it is plainly visible above the wood. Now connect the two inserted wires with a direct current, and almost at once the level of the liquid in one of the tubes will begin to rise rapidly. Reverse the current and the liquid will rise in the other tube. If 110-volt direct current is available use it in series with a large lamp, or several lamps in multiple. If only alternating current is available, place the small rectifier just described in the circuit and the result will be the same.



Liquids are carried with electric currents

It is certainly mystifying at first glance to



Experiment with a salt water solution to illustrate the idea of difference of potential

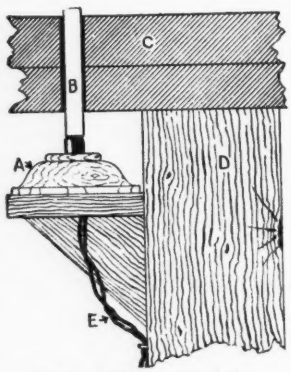
dip the tip of a wire into the center of a jar of salty water and see two lamps light up while a very small one remains dark, only to light up when the wire is moved a little off center—either way—without any change having been made in the connections. The

accompanying diagram will illustrate how this may be done. The large lamps are ordinary 110-volt bulbs, while the small one is a battery lamp of 6 to 10 volts.

This experiment well illustrates the idea of difference of potential. When the tip of the wire is exactly in the center of the jar, the circuit is "balanced" and no current flows in the circuit of the small lamp. This differential method of control has one marked advantage over the rheostat in experimental work in that it is possible to start with absolute zero.—JOHN D. ADAMS.

A Homemade Floor Push Button for Annunciators

A SIMPLE method of making an ordinary push button serve as a floor button for summoning the maid from the kitchen to the dining-room is shown in the illustration. Such a push has been in use for several years and is still in commission. The button was connected with the door bell system in such a manner that all the wiring necessary was across the small space from the button in the floor to the regular line.



Push button on joist with floor connection

The button *A* was placed in a small bracket nailed to the adjoining joist *D* and a hole bored through the floor *C*. A short stick—a lead pencil will do—was passed through the hole and allowed to rest on the button, as at *B*. The wires *E* lead to the bell circuit. A prearranged signal differentiates between a call from the front door and one from the dining-room or kitchen.—PHILIP MYERS.

Imitating Hard Rubber with Fiber as a Base

THERE are numbers of wireless amateurs and electrical experimenters who are desirous of using hard rubber panels and bases, but who are unable to pay the almost prohibitive prices. Ordinarily, fiber cannot be substituted, for it has a tendency to warp and is very dull in finish. If, however, the instructions as given are carefully followed out the resulting piece of fiber will be so nearly like hard rubber that it will take a close examination to detect the difference.

The first operation is in smoothing down the rough surface with a piece of No. 1 sandpaper. When it feels smooth to the touch, continue with No. 00 emery paper until it shines in spots, then wipe with a cloth and finish with a cleaning compound, such as is used in kitchens, smoothing lengthwise only in long strokes. Continue this until it shines all over. For the second operation wipe all the dust off with a clean cloth, and then with another cloth apply a coating of hard wax, such as is used on furniture and floors. The wax should be slightly colored with an aniline black. Allow the wax to harden for about 30 minutes and then polish with a brush, finishing with a soft flannel cloth. Apply two coats as described, not less than 6 hours apart. A perfect finish will be the result. As the wax is waterproof and not affected by any ordinary temperature, the fiber will not warp. This has been used with perfect success on a panel 25 in. long and 15 in. wide in a somewhat pretentious mahogany cabinet.—R. G. YOUNG.

Using a Well for a Wireless Ground Connection

WHEN a well is used for a wireless ground connection, the ground wire should be fastened to the top of an iron pipe leading to the bottom of the well by solder or by using a ground clamp. The pipe should be carefully scraped before the clamp is put in place. If it is desired to make connection directly with the water, brass and copper wire must be avoided because they have a bad effect upon the water. Often a well-ground of this sort will improve the range of an isolated station.—OTTO KLATT.

Holding the Telephones Tightly Against the Ears

A COIL of wire or a brass spring slipped on the cord to the wireless telephones will hold them firmly against the ears. When in use the spring or coil is slipped up over the leads and brought up under the chin. This not only holds the telephones in place, but also eliminates trouble from noise of wind, passing wagons and the like.—G. P. KOMP, JR.

Armature Winding for Small Series Motors

ON large generators and motors, the armature coils are wound and shaped on a form. This method is applicable to

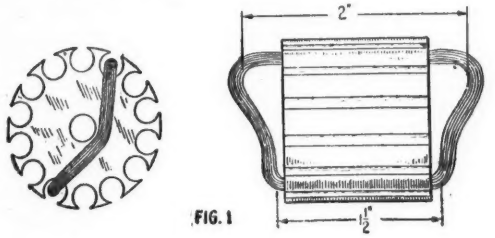


FIG. 1

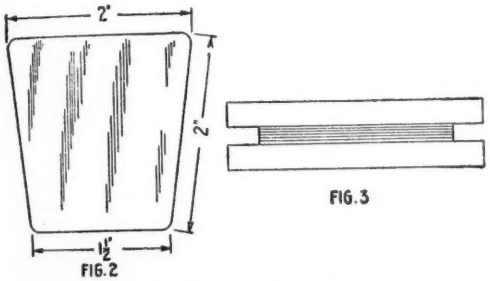


FIG. 2

FIG. 3

Measuring the length of an armature coil with wire solder, and the pattern for the form

any slotted core. Consider in detail the winding of small series motors such as are used to run vibrators, massage outfits and small grinders. These motors are usually very small and a higher degree of heating must be allowed than in larger machines. The resistance of the motor must be high to prevent too much current flowing through and dangerously overheating its windings. These little motors are too small and inefficient to generate much counter force, so high internal resistance is a necessary feature. The current through the motor is only about .1 ampere. With so small a current as this the motors heat too much to run for long periods at a stretch. Also, the radiation of heat from the windings is very poor, due to the large percentage of cotton insulation in small wire windings. The wire is very fine in the motor—about No. 32 double-cotton-covered on the fields and as fine as No. 36 d. c. c. on the armature.

As these motors are bi-polar, the armature coils go through slots 180 deg. apart. Commutators usually have at least 12 segments, so as to keep the pressure across adjacent commutator bars below 10 volts. Some have more bars. With high voltage between bars, sparking will be bad and metal particles will easily cause adjacent bars to short-circuit.

For example, in winding a 14-slot core that has a 14-bar commutator, there will be 14 coils and the size of wire will be No. 36 d. c. c. Before the form is made we must get an idea of the shape and size to make the coils. Remember that an armature winding is symmetrical; that is, the coils are just alike, having the same shape, the same position in the slots and the terminals all coming out similarly. One side of a coil is put in the bottom of its slot and the other side of the coil goes in the top of the slot on the opposite side of the core. Now with a piece of wire-solder or lamp-cord you can make a pattern of the coil and see how it will work when done. See Fig. 1. Measure the length of the top and bottom sides of the coil. Say the top is 2 in. and the bottom is 1½ in. Now take the pattern out of the slots, pull it out straight and measure it. Say it measures 7½ in. Deducting 3½ in. for the two sides, there is left 2 in. each for the two ends of the coil. Now make a form with these figures for its dimensions. A piece of thin board ⅛ in. thick will do. Cut out the side pieces for the center form and screw all three together. See Fig. 2 and 3. This can be mounted in a lathe or anything else you have with which to turn it.

To determine the number of turns per

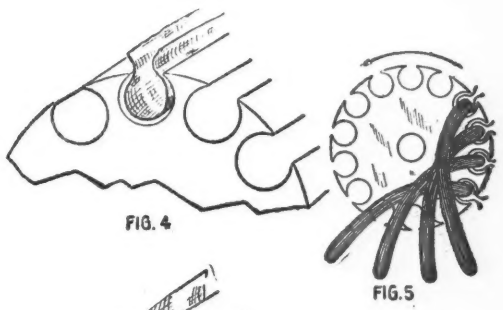


FIG. 4

FIG. 5

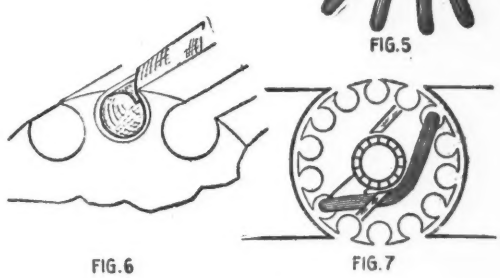


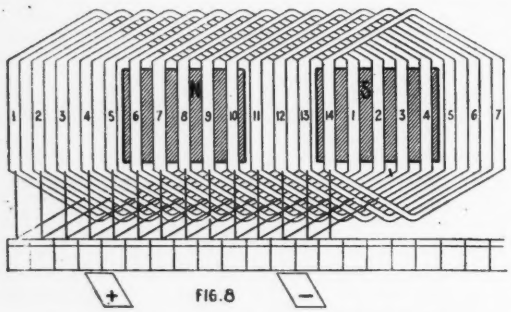
FIG. 6

FIG. 7

Placing insulating material in slots, inserting the coils, covering and setting the brushes

coil, cut short lengths of the wire and crowd the slot as full as you can, with say 720. Take ⅔ of that, or 480, as the proper

number to fill a slot. As one side of a coil fills but half of the slot, 240 turns per coil will be the requirement. Now wind 14 such coils, all alike and in the same direction. Use good wire. Never use a spliced or jointed piece of wire to make up a coil. Make a loop at the beginning of each coil before taking it off the form, so when the



The winding and the commutator as they would appear if laid out on a straight plane

time comes to connect with the commutator, the inner and outer ends can be distinguished. It is best to tie a turn of thread around the ends of the coils so they will not unwind or fall apart.

Now cut 14 pieces of Empire cloth and slip one in each slot, as in Fig. 4. Cut the cloth so it will project ⅛ in. past each end; the extra cloth sticking out on top will come in useful later. Now place the coils. Since the bundle of wire making up a coil is too thick to pass through the slot opening, the wires must be put in a few at a time until they are all in the slot. Squeeze them down to the bottom. Use no sharp tools to do the work. All the short sides of all the coils are successively put in place first. Always lay or place a given coil over and not under the one before. It is needless to say that the end of the coil with the terminals should face the commutator.

The placing of the coils is shown in Fig. 5. With all the coils half in, it is now well to connect them together. Start with any beginning wire of a coil and twist it together with the end of the coil occupying an adjacent slot. Keep on going around the core in the same direction. You will see that every coil on the core is in series with the one next to it. This is where our drum winding appears similar to a Gramme winding. Now tie a string around the whole core and coils and tighten it. Put your finger on any slot, and count slots in the direction the other side of your coil goes till you come to number 8. The slot your finger was on at the start counts as number one, so the coil will occupy slots 1 and 8.

If the coil does not seem to reach, keep on working all the coils toward their slots until they come down to shape. When all the coils are in, cut the extra Empire cloth off on top till only about ⅛ in. remains. Now, with the back edge of a knife, press these projecting edges of cloth in under the edges of the slot, as shown in Fig. 6. Then a fiber or thin wooden wedge can be driven in the top of the wire. After this, leave the whole armature in insulating varnish, enamel or shellac for a few hours, and bake the armature dry in a moderately heated oven.

When dry, scrape all enamel from the commutator and shaft. Now determine where the leads from the coils go to the commutator. If the brushes are placed midway between poles, have the lead come from a coil to such a bar that when the brush touches that bar the coil is *out of the field*, or in the gap between the field poles, as in Fig. 7. This is easy and all the rest of the leads follow successively. When you have them all soldered to the segments, the job is completed.

The winding just described is depicted in Fig. 8. This method of form winding has an advantage over hand winding, because on small 110-volt motors there are so many turns per coil that hand winding would be exceedingly slow and tedious.

In the case of the commutator having twice as many segments as core-slots, bring out loops from the coils when half wound. These terminals are joined to the alternate bars. It is simply a scheme to have a larger number of bars, and thereby cut down the voltage across each bar. If you have a 12-slot core and 6-segment commutator, you can make a coil occupy a whole slot or else connect two coils in series before any lead goes to the commutator.—GEORGE STURLEY.

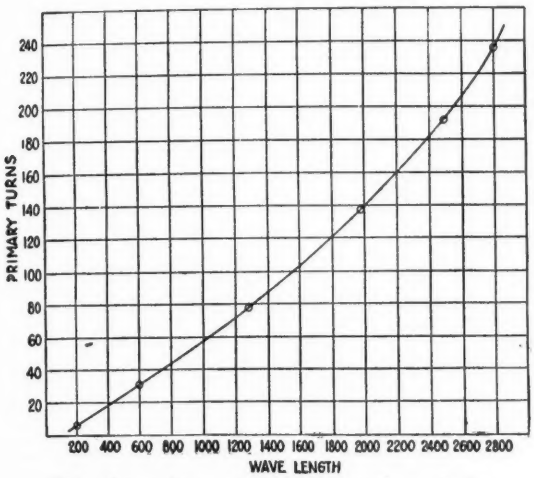
Calibrating the Receiver for a Wireless Set

A ROUGH, but very useful wavelength calibration of a receiving set may be made as follows:

Carefully tune the loose coupler to those stations using known wavelengths, being careful to select them so that the complete range of the receiver is covered, as 200, 300,

600, 1,000, 1,500, etc., meters. Make final adjustments, using very loose coupling. If a series primary-condenser is in the circuit, leave it at the same setting for all stations. Make a note of the number of primary turns used for the best adjustment for each of the stations.

On a sheet of cross-section paper, scale off the bottom in wavelengths the full range of the loose coupler, beginning at the lower left-hand corner. Scale off, the primary turns at the left-hand side and from the lower left-hand corner. Plot the points at the intersection of the turns and the wavelength, and draw through them a fair curve, such as shown in the diagram.



Plot the points at the intersection of the turns and the wavelength, and draw the curve

If the points do not line up, see if the plotting has been done correctly; if so, the assumed wavelength is in error.

Do not try to include the loading coil on the same curve, but make a separate one.

Only the primary is mentioned, because the majority of amateurs use "untuned" secondary systems. But if this is not the case the secondary may be calibrated the same way, if a fixed loose coupling is used. The secondary shunt-condenser value must remain constant. A set so calibrated may be instantly adjusted for any station, even though it has not been heard before, provided, of course, that its wave is known.

The curve shown was drawn from results obtained according to the foregoing explanation, with a large loose coupler. Note that the line is straight at the shorter wavelength increases. If the loose coupler had been much larger, the curve would have reached a place where it would be nearly a vertical line. In other words, a place would have been reached where a very large amount of inductance would have to be added to make a small increase in wavelength. With a larger antenna, this place would have been much farther out on the wavelength scale.

Making Small Slots in the Frame of Pancake Helices

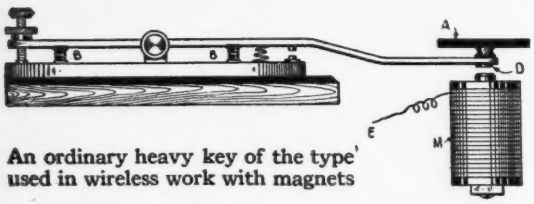
IN the construction of the pancake type of helices, the amateur is often puzzled over the method of sawing the slots in the frame of the helix in such a manner as to insure a snug fit of the brass or copper ribbon used. In the construction of the primary of such helices, where the ribbon is usually about 11/16 in. thick, probably the best method of sawing the slots for the ribbon is to use an ordinary hack saw. The blade generally runs pretty close to the size of the ribbon, and this gives a snug fit, without the necessity of "shims"—or small pieces of copper, brass, or wood fitted in the slots, which often result in a "messy" job.

In the secondary, however, the ribbon sometimes runs as small as gage 64. Saw blades of this size are very difficult to obtain, so the best way is to make your own blade. This can be easily done by securing a piece of an old clock-spring, which as a rule is very thin. Cut off a piece as long as your hack-saw blade, putting the two ends in a flame for a few seconds to draw the temper. A hole may then be bored in each end to fit the hack-saw frame. Draw the spring taut, taking care to hold it away from the face, as it will sometimes snap. Then press the "blade" against an emery-wheel till a series of "teeth" are notched in it. This does not make a very artistic looking job, but it will be found that it cuts into the frame—whether it be hard rubber or any of the finer woods—rapidly and with a clean stroke. Care should be taken to keep the blade cutting straight, as it will have a tendency to curve. If the right kind of clock-spring is used, a snug fit for the ribbon is assured.

The pancake type of helix is probably the easiest for the amateur to make up, provided he can secure the necessary ribbon. Although fiber or hard rubber is best for the frame, mahogany is very good, and is easily handled. On the primary, it is customary to space the ribbon ½ in. between turns, and on the secondary, where finer ribbon is used, ¼ in.—PAUL OARD.

Making a Simple Relay Key for Wireless Operators

THE arrangement in the diagram shows a simple and inexpensive method of constructing an efficient magnetic relay key to be used with an ordinary Morse key or automatic sender. An ordinary heavy key of the type used in wireless work is shown at



An ordinary heavy key of the type used in wireless work with magnets

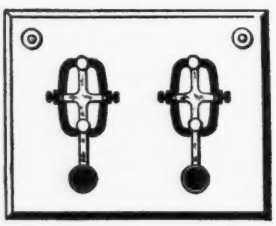
A. It is connected in the primary circuit of the transmitting transformer by the terminals *B* in the usual manner.

A pair of magnets obtained from an ordinary 4-ohm sounder is represented by *M* and fixed in the position shown in any convenient manner. A sounder armature *D* is fastened to the base of the heavy key lever just beneath the knob, by means of a screw and washer. The magnet coils *M* are connected in series through their terminals *E* with several dry or storage-cells and an ordinary Morse key.

It will be readily seen that with this arrangement, manual operation of the light key will cause simultaneous operation of the heavy relay key automatically. By substituting a vibroplex sender in place of the small key, perfectly satisfactory results may be obtained. Care must be taken to adjust correctly the spring tension on the key lever of the heavy key to secure the best results.—NORMAN A. WOODCOCK.

A Multiple Key for Sending Wireless Messages

BY mounting two key levers side by side on a common base a high speed hand-operated transmitter in its simplest form is obtained. The keys should be connected in parallel. Adjust the spring on one so as to raise the lever sharply for the dots, and the spring on the other so as to work more slowly, for the dashes. Two easily built strap keys are suitable for the purpose.

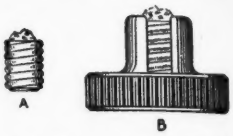


Two telegraph keys mounted for fast sending

Care is necessary in order to send good, fast, clean-cut Morse in this way, but with a little practice it can be done, and operating speed will gradually increase. Both keys are of course manipulated with one hand.—JOHN B. RAKOSKI.

A Novel Crystal Support Made of Flashlight Globe

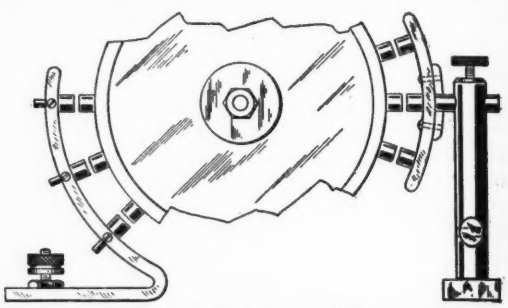
IN the illustration, *A* represents the base of a miniature flashlight bulb, all parts except the shell having been discarded. When this is half filled with solder the crystal is molded in. A set of minerals may thus be mounted to work in conjunction with a miniature porcelain base socket, *B*, which is fastened to the detector base. The mineral itself may be screwed into place and rotary adjustment of the mineral secured in the same manner. Contact is made from both binding posts of the base socket.—JOSEPH BRAFF.



The lamp screw and the porcelain base

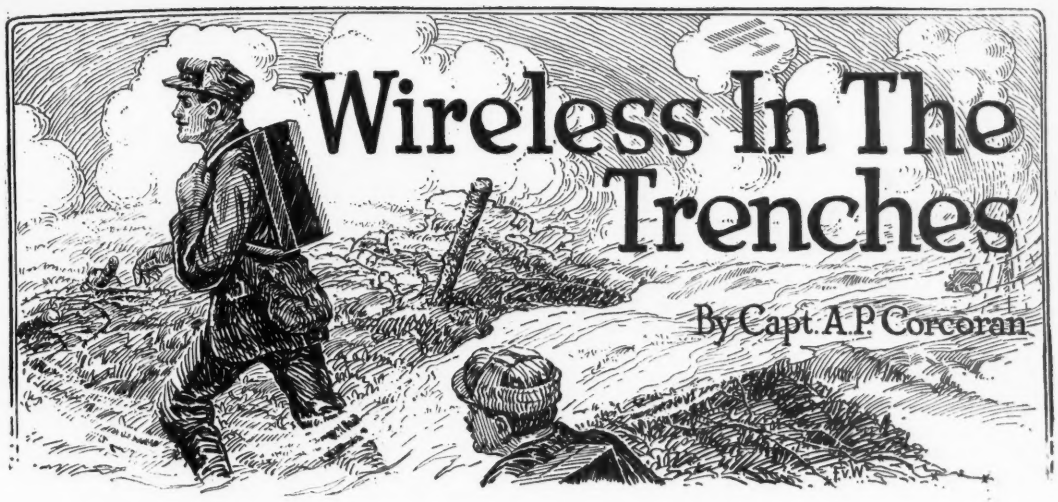
A Multiple Electrode Rotary Spark-Gap

IT is a well known fact that there is a great deal of energy lost in heat at the electrodes of the spark-gap. This is particularly noticeable and very objectionable in a plain open gap. The rotary-gap overcomes the difficulty to a certain extent, on account of the cooling action of the wheel; but most amateur rotary-gaps can be improved upon in this respect.



Multiplying the electrodes will increase the efficiency of transmitting apparatus

An increase in radiation will be noticed in most cases if a number of electrodes are used in place of single stationary electrodes. The arrangement shown in the drawing is simple and will amply repay the careful builder.—W. A. PARKS.



Wireless In The Trenches

By Capt. A. P. Corcoran

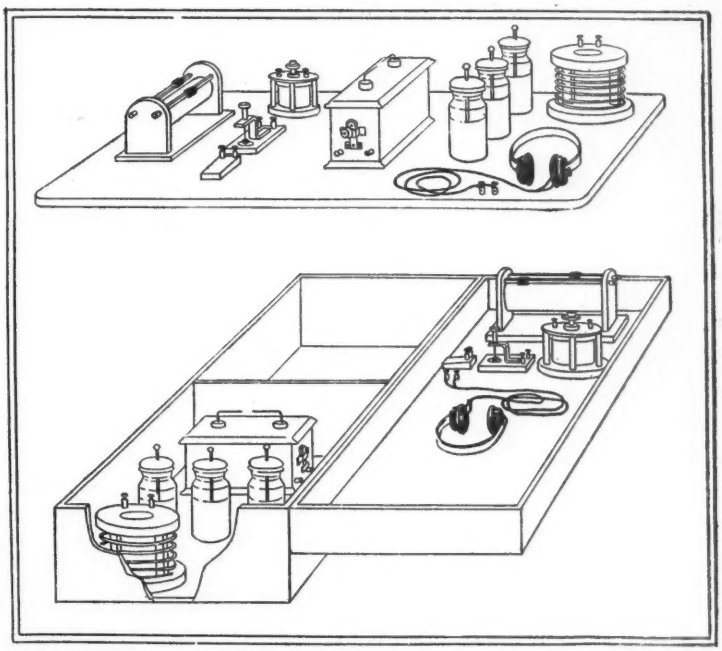
The author of this article, Capt. A. P. Corcoran, has just returned from France, where he served with the British army. His military work included the installation of signaling apparatus. The following contribution from his pen, therefore, will give our wireless readers some first-hand information on the war-time usage of radio apparatus.—EDITOR.

TO the public at large there is little that is romantic in the performance of the wireless man in warfare. He does not charge with bayonet fixed to rush an enemy trench. He does not kill or conquer. And the popular imagination finds it hard to see a hero in a man whose duty is the mere recording of others' exploits.

Like the dispatch-rider, indeed, the wireless operator is likely to become conspicuous only when he fails in the task assigned him. Then he has an opportunity to judge his importance by the measure of the opprobrium poured on him. When he fails, of course, he never fails alone.

Yet technical and unheroic as his task may seem, it calls for gallantry equal to that of any. Not only does he share in all the risks run by the Tommies, but he lacks all their means of defence. Though he stands side by side with them in the front line trench, ready to join in the attack, his sole weapon is his wireless apparatus. He carries neither rifle nor bayonet.

The position of the wireless man is now quite definite. There is no scrap in which he does not have his share, no division of the army in which he does not have his place, whether it be infantry, artillery, air-service or cavalry. That he is absolutely indispensable in achieving results has been conclusively proved in the battles along



The first set was placed loosely on a board, but it soon became apparent that a different outfit was needed and one more easily transported; hence the box set came into use

the Somme by endless instances of distinguished services rendered. In spite of his obscurity, he has won many decorations.

But that his service is still far from perfect, however effective it has proved, was still evident when I left France less than a year ago. I do not intend to be technical in my explanations in this article, but, in order to make clear the experimenting that has been done in wireless in this war, it is necessary for me to go back to the beginning. My aim is to give a short history of the wireless in France—its development in brief outline.

At the very outset of hostilities, before the trench warfare had begun and the armies had settled down to their present deadlock, the wireless was necessarily of a different character from that used now.

Then a motor lorry set—a 1½ K. W. Marconi set—was supplied to the Signal Branch of the Royal Engineers. All through the retreat from Mons and during the fight on the Marne, this set was used and did excellent work.

But with the end of the moving fighting and the beginning of trench monotony, the lorry set lost its value. Soon it was entirely supplanted by the systematic working of trench telephones, and for a while the wireless went almost completely out of use.

But not for long. The ineffectiveness of trench telephones under certain conditions was soon very painfully apparent. When actual fighting was in progress, they failed more than once at critical moments. Sometimes a shell would break down the communications; or an artillery battery would carry off the air line poles; or an enterprising Tommy, on his way through a communication trench, would cut off a length of cable to make a shoe lace.

Even commanding officers who were always sceptical on the subject of wireless in the trenches, were forced to confess that their old friend, the telephone, was not always reliable in case of a crisis. So, on their recommendation, it was decided to undertake some experiments which would perfect the wireless for warfare.

It was now decided that the requirements of the new fighting called for a portable set for the first line trenches, and a group of officers who had already distinguished themselves in various capacities, were detailed to take charge of the work and evolve an instrument for the purpose.

They introduced a small, simple set consisting of a 1-in. spark coil, Leyden jar condenser (3) and an aerial coil. Receiving, a single inductance, silicon detector, variable capacity 'phone condenser and 'phones 1000 ohms. The aerial was supported on two 8-ft. bamboo poles, 80 ft. apart with a single wire. The ground consisted of a wire gauze mat 8 by 3 ft. With this set it was discovered that fairly loud signals could be heard from three to five miles.

When the instrument, however, was put to its first real test at L——, it rose magnificently to the demands of the situation, acting to its full range of five miles.

For a long time this set was used with excellent and unvarying results. In regard to the transmission of messages it lacked nothing. But it had just one drawback—a minor one but occasionally important. Being placed loosely on a board, it was clumsy to carry, a fact which often hindered the work by causing loss of time.

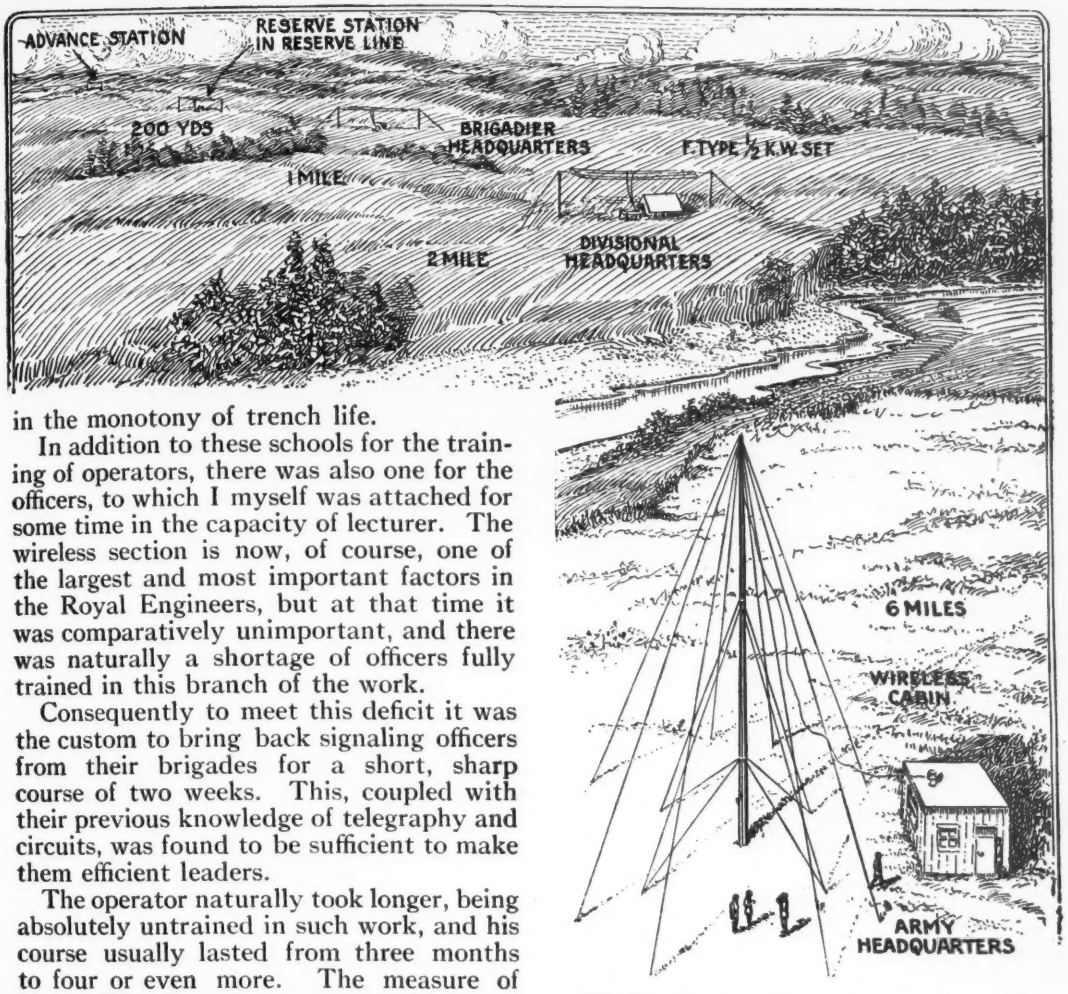
Once more the officers set to work. It was a Captain L—— who found the means of combating the difficulty. He discarded the board, and substituted a box 18 by 9 by 9 in. in which he placed the set. This was carried on the back and proved to be a most compact and convenient instrument.

I remember when the first experiments were made with this set, some distance behind the line. They took the form of contests between the wireless and telephone. A detachment from each would start off from a trench, as if during an actual engagement, to a position some 500 yd. distant. Then each would do his utmost to establish communications as quickly as possible.

From the very first the wireless man won by an average of some thirty seconds, no small consideration in warfare, when perhaps it is a question of holding ground already gained.

The instrument being now perfected, the next question was the training of the men. In England depots were at once established, and young fellows already equipped with a working knowledge of the job, such as Post Office Telegraphers and the like, were enrolled in the wireless section.

Similar schools were established in France behind the lines at each of the Army Headquarters, and the officers in charge would occasionally go into the trenches and pick out a few of the most intelligent infantry men with a view to training them as operators. No Tommy but tried his hardest to be picked. He looked on the training as a good opportunity to rest, a nice break



Wireless stations along a line for six miles, the last one using an umbrella type aerial

in the monotony of trench life.

In addition to these schools for the training of operators, there was also one for the officers, to which I myself was attached for some time in the capacity of lecturer. The wireless section is now, of course, one of the largest and most important factors in the Royal Engineers, but at that time it was comparatively unimportant, and there was naturally a shortage of officers fully trained in this branch of the work.

Consequently to meet this deficit it was the custom to bring back signaling officers from their brigades for a short, sharp course of two weeks. This, coupled with their previous knowledge of telegraphy and circuits, was found to be sufficient to make them efficient leaders.

The operator naturally took longer, being absolutely untrained in such work, and his course usually lasted from three months to four or even more. The measure of his qualifications, however, was high and definitely fixed. He had to be able to send and receive at the rate of twenty-five words a minute, English, and twenty words a minute code and foreign languages. He had to be able to assemble and dismantle Marconi 1½ K. W.; also to have a working knowledge of trench sets and a thorough knowledge of army procedure.

As a matter of fact, he rarely needed to work to the full height of his ability, for, in actual warfare, he found that the necessary speed rarely exceeded from fifteen to twenty words a minute, according to the activity of the Boche gunners.

The wireless, as I have said, is now an essential part in all trench warfare. When the infantry advances to an attack, the operator is always slightly in the rear. Where formerly a detachment of men had to reel out hundreds upon hundreds of yards of cable to establish telephone communication between a trench newly taken from the enemy and the first line reserve behind, now the operator simply picks up his box, his ground mat and his aerial single-handed and advances simultaneously with the attackers. Arriving at his new position, he props up his aerial, lays his ground mat, and communications are established almost at once.

It would be hard to overestimate the importance of his duties. When an enemy trench is being taken, it is he who reports the progress of the encounter—the number of the enemy, the nature of their defence, the amount of the casualties on either side, the condition of the trench when it is finally taken—whether it has been badly damaged by artillery fire, or whether it is practically intact. If a gas attack is com-

ing, it is he who sends the warning to the men behind to put their gas helmets on.

If the aeronaut can be called the eyes of the army, the wireless man is its ears. Naturally their work is made to dovetail. When one sees, the other hears and also reports.

One of the main duties of an aviator, as you probably know, is to reconnoiter for the army, and to report on the accuracy of the artillery fire and on the location of the enemy batteries.

But he does not have to descend to report his discoveries. For he, too, is equipped with a wireless set—a Wilson set is the one usually carried—with which he transmits his information to the man below.

This man is stowed away always in a dug-out, at a little distance from the battery. It is in accordance with the information he receives and transmits that the artillery fire is directed.

Every branch of the army, as you see, has its own particular station, and its own particular duties to discharge.

Back at Army Headquarters where the large station 1½ K. W. Marconi is situated, the work of the wireless mainly consists in intercepting communications from the enemy and taking aircraft reports. But though each of these stations works separately, they are all in close touch at all times.

For instance, every battalion carries two trench sets, each having two operators. They are in the front line with the infantry. Back with the reserve, about one hundred yards behind, are two more sets and two more operators. Back still further is a larger set at Brigade Headquarters. At Divisional Headquarters is a ½ K. W. set, and at Army Headquarters is a 1½ K. W.

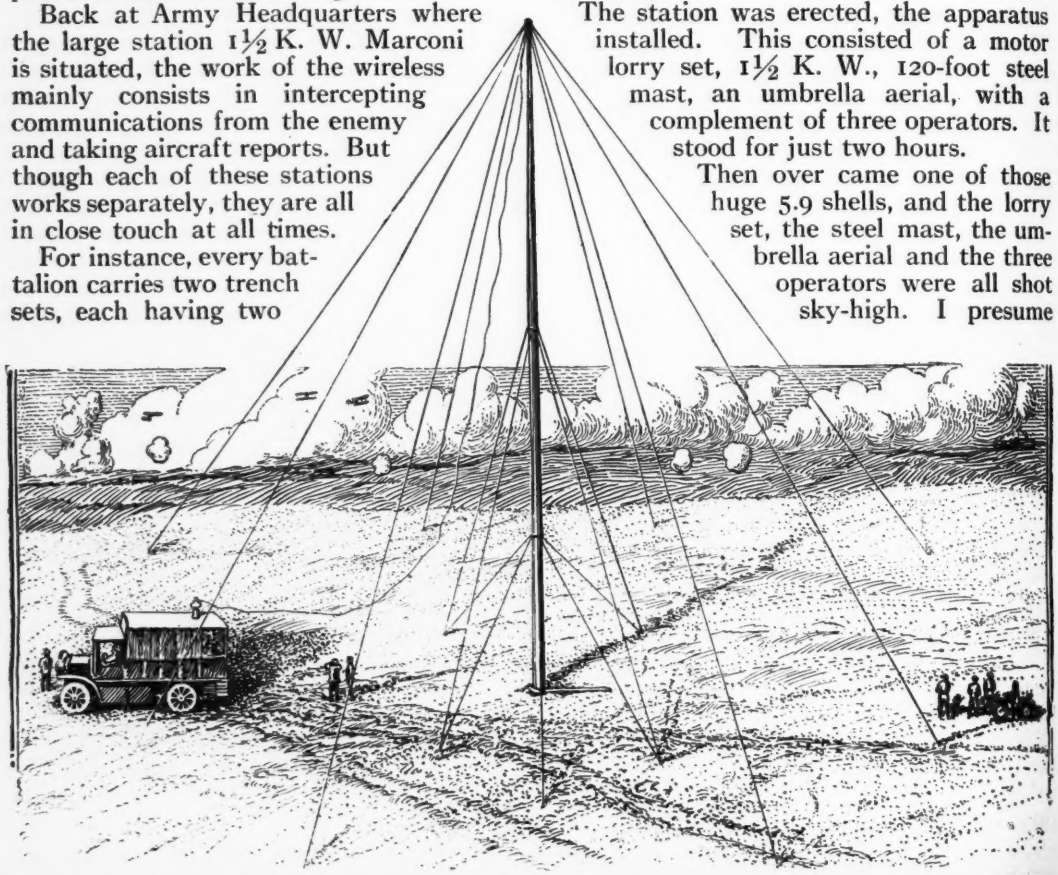
An attack is made. The battalion operators go over slightly in the rear of the infantry. They communicate with the station in reserve, who in turn pass it on to Brigade Headquarters, who pass it along to Divisional Headquarters, who report it to Army Headquarters.

A few have asked why this method of communication is adopted, and have suggested that it would be more effective if one large set were established close behind the line, to replace all these individual trench sets. Communication, they say, would then be direct with General Headquarters, and much time might be saved.

That was tried. I remember the occasion distinctly.

The station was erected, the apparatus installed. This consisted of a motor lorry set, 1½ K. W., 120-foot steel mast, an umbrella aerial, with a complement of three operators. It stood for just two hours.

Then over came one of those huge 5.9 shells, and the lorry set, the steel mast, the umbrella aerial and the three operators were all shot sky-high. I presume



Back at Army Headquarters, where the large Marconi station is situated, the work of the wireless consists mainly in intercepting communications from the enemy and taking aircraft reports

they have since then come down again.

The result of this experiment, naturally, was an increased regard for the trench sets. But these were by no means perfect as yet.

Of course, in addition to the latter, there are automobile sets, aero sets, wagon sets which are used for all moving fighting, and pack sets for the infrequently active cavalry. But none of these has required the time and attention devoted to the instrument used by the infantry.

As the aerials have to be erected over the trenches, the poles being stuck on the parapet, they were naturally attractive targets.

Naturally their operators came in for their share of the snipers' shells.

In this connection, I would like to tell the story of a friend of mine, Lieutenant L., which will bear out my contention that, when it comes to the scratch, a wireless man can be as cool as the next.

He was adjusting one of the stays of his aerial pole which had been disturbed by the falling of a shell close by. As he was doing so, over came a second shell, known to the Tommies as a "whizz-bang," which gave him a direct hit, tearing his arm clean away, except for a stump of 4 inches. He looked at it calmly for a couple of seconds.

"Well, that's a ticket for blighty," he exclaimed then, and fainted. (Blighty, it might be explained, is a Hindustanee word for home which the Tommies have adapted for their own use from the vocabulary of the Indian troops.)

It was such accidents as this, however, combined with the occasional collapse of the aerial, that convinced the authorities of the need for further experimenting. The officers were now given a more or less free hand to test ideas of their own.

When I left France, many new devices had already been introduced. From what I hear, they have since been perfected.

An Easy Way to Wind Sending Helices

IT IS often very troublesome to wind aluminum or copper wire into a circular form for helices or oscillation-transformers and make a neat job. The following method will be found very satisfactory for the amateur.

Secure some old lumber 2 in. or more thick and with a compass lay off a circle or circles, which should be smaller in diameter than the diameter of the helix to be made. A good rule to follow is to make the diameter of the disk of wood about 2 in. less than the finished helix. Though the resulting coil may then be a little too small, this may be easily corrected in assembling the instrument.

Cut out the disks of wood with a scroll-saw and be sure they are perfectly round. Make a hole in the circumference of each disk just large enough to receive the wire. Bend the end of the wire at a right angle, insert the bent portion into the hole and fasten with a staple. Wind the wire on the drum the required number of turns and allow the wire to remain in this position for a short time, when it may be removed and used. A disk of cardboard cut to the correct size, may be used as a gage to determine whether the helix is kept the right size while assembling.

Improving the Wireless Aeroplane Set

THE past year will go down in radio history for the memorable advances which were made in radio communication from aeroplanes—an advance directly traceable to the European war. The lessons taught by the great conflict were not lost upon our Navy Department. As a result, more official encouragement has been given to manufacturers and developers of wireless apparatus in this country than ever before. At the end of 1916, the Navy Department issued requisitions for fifty aeroplane sets. This was the result of three different tests. So successful were the tests that the Navy Department felt itself justified in placing an order for fifty sets at the end of December 1916.

From the Marconi Company sixteen sets were ordered to be operated on the 500-cycle, quenched spark principle. Nineteen sets of the audion type were ordered from the De Forest Company. Thirteen Dubilier sets, using the direct current quenched arc, were ordered from the Sperry Gyroscope Company.

The awards were sufficiently generous to encourage the manufacturers, amounting as they did to about $60,000 altogether. Thanks to the Navy's interest in wireless, we are now far in advance of any European nation in the art of communicating by radio from aeroplanes. We can send twice as far as any other country from the air.

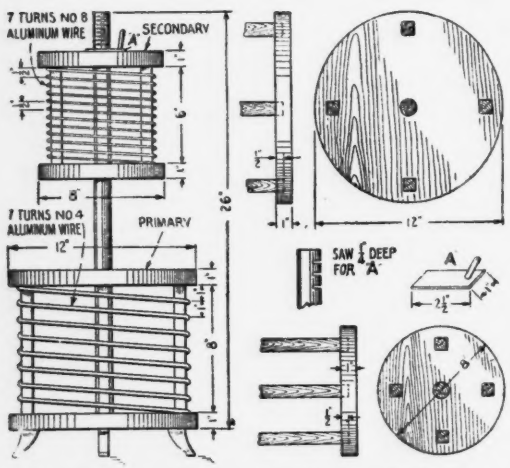
It is interesting to note the characteristics of the successful sets. The Marconi Com-

pany submitted a 1-kilowatt set complete which weighed 100 lb. Each of the De Forest audion sets weighed 86 lb. The Dubilier quenched arc set weighed 64 lb. The three sets in question were given rigid scientific tests, each manufacturer having seen to it that his apparatus was absolutely foolproof.

Mr. Dubilier's system is particularly interesting. Formerly Leyden jars were broken and short-circuited. The entire set was out of commission until the broken jars could be renewed. Hence, warships, as well as airships, were in danger when the Leyden jars gave out. In the Dubilier system, the secondary is not short-circuited, whatever happens, but continues to work uninterruptedly. Hence, it is practically impossible to throw the set out of order.

How to Make a Sending Oscillation-Transformer for Wireless

THE construction of the oscillation-helix is shown in the illustration. The heads of the primary or larger coil, are



A sending oscillation-transformer that will prove valuable to any wireless station

1 in. thick and 12 in. in diameter, and are held apart by four strips of wood 9 in. wide and ¾ in. thick, which are placed in ½-in. notches in the disks as shown. This makes the distance between the two heads 8 in. The lower head is provided with three legs, which may be made of fiber. Insulators screwed to the bottom of the head will answer the same purpose. A 1-in. hole is drilled in the center of each head to admit a 15/16-in. dowel or a piece of curtain pole of the same diameter and 26 in. long. Several slots ¼-in. deep are sawed near the top of this vertical rod. A small strip of brass is made to fit into any one of these slots, the purpose being to hold the secondary in place after the proper coupling between the primary and secondary has been determined.

When all of the parts of the primary have been assembled, it is wound with 7 turns of No. 4 aluminum wire as shown. The secondary, or smaller coil is next made, the heads being 8 in. in diameter with a 6-in. space between them. It has four uprights which are notched into the upper and lower heads in the same way as in making the primary. The heads of the secondary are drilled centrally to admit the dowel. When the secondary has been assembled it is wound with 11 turns of No. 8 aluminum wire. The strip *A*, which holds the secondary in position, is made from a piece of 1/16 in. copper or brass 2½ in. long and 1 in. wide. One end of the strip is drilled for a small handle while the other end is drilled to admit a screw that holds the strip on top of the secondary.

The oscillation-transformer will be a valuable addition to any wireless station and will help comply with the wireless law regarding pure waves and wavelengths. It can be used with a transformer up to and including 1 K. W. input, and has just the right amount of inductance in the open and closed circuit sides to permit a range of periods well above and below 200 meters.

Testing the Sensitivity of the Telephone Receiver

A VERY simple experiment illustrating the extreme sensitivity of the ordinary telephone receiver may be made as follows: Connect each terminal with about 2 ft. of magnet wire of small enough gage to be easily handled. Connect the free end of one wire to a small scrap of clean sheet zinc. Then while the receiver is held to the ear with the left hand, moisten the end of the other wire on the tongue and touch it to the scrap of zinc. Immediately a definite click will be heard in the receiver, thus registering the infinitesimal current generated by this minute galvanic battery.

Most amateurs fail to appreciate the value of the watch-case receiver in testing for leaks and short-circuits, and accordingly resort to magnetos or galvanometers which are not nearly so sensitive, as a rule. If you have a galvanometer subject it to the above test.—JOHN D. ADAMS.